

APPENDIX 10

PRELIMINARY HYDROLOGY STUDY (HS)



PRELIMINARY
Hydrology Study

October 23, 2025

**APN: 0435-163-024,
East of Deep Creek Road and
North of Rock Springs Road.
San Bernardino County
Unincorporated Area, CA.**

RBCEA PROJECT NO.: 220028



**PROFESSIONAL ENGINEER'S
AFFIRMATIVE STATEMENT**

I have examined and am familiar with the information in this document and all appendices; and based on my inquiries of individuals immediately responsible for obtaining the information in this document, I believe that the information is true, accurate, and complete.

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APPENDIX A

- Exhibit A - Location Map Exhibit B - Soils Type Report
- Exhibit B – Soil Report
- Exhibit C1 - NOAA 14 Precipitation Depths
- Exhibit C2 - Antecedent Moisture Condition
- Exhibit D1 - National Flood Hazard Layer FIRMette
- Exhibit D2 - USGS Blue Line Streams
- Exhibit E1 - Aquatic Resources Ephemeral Drainage Delineation
- Exhibit E2 - Aquatic Resources Streambed Delineation
- Exhibit E3 - Off-Site Tributary Watershed
- Exhibit E4 - Off-Site Tributary Subareas
- Exhibit-F1 - 2,677 cfs On-Site Channelization
- Exhibit F2 - Pre-Developed Hydrology Map
- Exhibit G - Post-Developed Hydrology Map
- Exhibit H1 - Manning's Calc 2,677 cfs On-Site Channel
- Exhibit H2 - Manning's Calc 49 cfs On-Site Channel
- Exhibit H3 - Manning's Calc 75 cfs On-Site Channel

APPENDIX B

- Off-Site 1902-Ac 100-Year Unit Hydrograph Method 24-Hour
- On-Site Pre-Developed 25-Year 1-Hour Storm
- On-Site Post-Developed 100-Year 1-Hour Storm
- On-Site Post-Developed 100-Year 24-Hour Unit Hydrograph

APPENDIX C

- GeoTek, Inc. Infiltration evaluation dated June 29th 2023.
Project #3579-CR=

I. INTRODUCTION

A. Location of Property

The proposed project is in the unincorporated area of the County of San Bernardino, California and within the Town of Apple Valley Sphere of Influence. The Parcel land area is 23.37 acres and the Assessor's Parcel Number (APN) is 0435-163-24 and the Freight Container area is 17.89 acres. See Exhibit A for-Location Map.

The site currently consists of one undeveloped lot with access from Deep Creek Road on the west and lies contiguous to the elevated railroad tracks north of Rock Springs Road and along the Easterly property line. The western portion of the lot is flat and slopes gently to the northwest while the eastern portion slopes steeply up to the east and the railroad tracks. The eastern slopes are covered with several Joshua trees, blue sage, and annual grasses while the west portion of the site is rabbit bush and annual grasses.

The 17.89 portion of the site is currently used as a Freight Container Storage Area under a Temporary Use Permit (TUP) PROJECT NO. PTUP-2022-00036 and the filing of a Conditional Use Permit Application (CUP) PROJ-2022-00082 to allow for continued Freight Container Storage. The TUP project permit approval became effective on February 20, 2023, and has been extended to February 20, 2026. proposed use of the site will be an empty freight container storage area. No permanent development is proposed, and the freight containers will be elevated 4-inches above natural grade level to allow full site infiltration

B. Purpose and Scope

The purpose of this study is to determine if containers placed on the agricultural site will affect downstream developments level of flood protection in a significant negative way.

C. Floodplain Information

The project site is located inside of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Panel 06071C6515J effective September 2, 2016. This panel indicates that the site is located within Zone D, defined by FEMA, which is not within a special flood hazard area. (See Appendix A, Exhibit D)

D. Methodology

This study is based on the San Bernardino County Hydrology Manual, the April 6, 2010 Addendum that addresses the Antecedent Moisture Condition (AMC) for Arid Regions of the County, the Detention Basin Design Criteria for San Bernardino County (including the referenced September 4th, 1987 Interoffice Memo), and CivilDesign Rational Method and Unit Hydrograph Software to model the storm channel flows.

The following criteria were used to calculate the flow:

1. Current land use: Agricultural Farmland
2. Rainfall Intensity Curve Slope Desert Condition: 0.70
3. On-Site Proportion Impervious: Native Soil 0%
4. Intended Use: Industrial Building and Truck/Employee Parking
5. Soil Type: Hydrologic Soil Groups A (See Exhibit B)
6. NOAA 14 Precipitation Frequency: 100-Year 1-hour = 1.10 inches (See Exhibit C1)
100-year 6-hour = 2.20 inches
100-year 24-hour = 4.06 inches
7. Antecedent Moisture Condition AMC II Developed Lands (See Exhibit C2)
8. Percolation rates 0.45 to 0.74 minutes per inch

II. OFF SITE HYDROLOGY

A. Off-site drainage description

A 1,902-acre off-site tributary watershed lies to the southeast of the project site. The longest flow path extends 15,238 lineal feet to an elevation of 4900 feet in the surrounding foothills (see Appendix A, Exhibit E3). Consisting of steep upper hillsides flowing through sandy gravel channels, the channels can be considered natural valley channels with a manning's "n" value equal to 0.33 flowing through scattered sage brush, annual grasses, and an occasional Joshua tree. The lower areas fan out onto a sandy alluvial deposit prior to being captured / detained by an elevated Rock Springs Road. These flows must rise and spread out 1 to 1.5 feet in depth prior breaching the top of the road. If the flows breach the road, they are captured in the road and conveyed to drainage culverts that direct the flows north into an existing 2- ac-ft drainage basin on the north side of Rock Springs Road (see Appendix A, Exhibit E4).

An Aquatic Resources Delineation (ARD) was conducted on the proposed Project Site by ECORP Consulting, Inc. Environmental Consultants dated October 2024. The Study area consisted of off-site Assessor's Parcel Numbers 0438-163-37, -43, and -44 totaling 47.10 acres as well as a portion of the public right-of-way along Deep Creek Road including the 17.89 acre proposed Freight Container Storage-Yard portion of Assessor's Parcel No. 0438-163-24 encompassing 23.37 acres.

After ECORP biologists Chelsie Brown and Eliza McLean walked and visually inspected the entire 47.10-acre Study Area, they determined the location and extent of aquatic resources within the Study Area as shown in Appendix A Exhibit E3. It should be noted that there was no visible evidence of a Streambed in the container site area.

Nevertheless, they did find a streambed that bisects a small area at the northeast corner of the site that is part of a neighboring off-site area not tributary to the Freight Container Storage Area as shown in the ARD report as Feature 1 in Figures 4 & 5 (See Exhibits E1 & E2) that also disappears once it reaches the lower elevation soil strata like the project site.

Further, there are currently no USGS Blue Line Streams mapped on the subject property nor within the tributary watershed as depicted on EXHIBIT D2 – USGS Blue Line Streams included herein. Thus, we can assume similarly that the off-site flows infiltrate underground and do not exceed the

basin capacity, nor do they flow north to the railroad trellis under crossing, which is elevated above the surrounding topography acting as a berm that restricts off-site flows from entering the southwest corner of the property.

B. Off-Site Hydrology

The off-site tributary watershed as shown on Appendix A, Exhibit E3 were analyzed using the unit-hydrograph method which uses Lag to determine the flows.

Given the following

Area = 1,902 acres

$Ct = 24\bar{n}$ ($\bar{n} = 0.033$)

L = 15,238 feet = 2.88 miles

Lca = 7,182 feet = 1.36 miles (to the Centroid)

S = $(4900 - 2888) / 2.88 = 697.2$ (feet/mile)

m = 0.38

Then $Lag = Ct * (L * lca / s^{.5})^m = 0.349$ hours

Entering this data into the unit hydrograph analysis calculates the 100-year 24-hour peak flow storm flow in the magnitude of 2,677 cfs. Yet, due to the many obstructions in the flow path prior to entering the site, no evidence of this sizable flow, such as scarring, vegetation, or discoloration, suggests that these concentrated flows have traveled across the site which has been confirmed by the on-site Aquatic Resource Delineation field survey conducted ECORP. In fact, the owner has not witnessed any off-site tributary flows entering the site from under the railroad trellis in the last 50 years.

On August 20th, 2023, Tropical Storm Hilary provided the evidentiary and supporting empirical data of these field observations. This post-tropical cyclone occurred for the first time in California's last 26 years of history, causing severe flooding in Southern California where recorded rainfalls reached 13.5-inches in San Bernardino County as shown below:



Photo 1

WWW.LATIMES.COM

Yet, Photo 2 shows the basin just south of the property only had minor storm water at the bottom of the basin and Photo 3 shows the storm drain culvert outlet east of the basin releasing up to storm flows on the north side of Rock Springs Road showed little to no concentrated flow scouring as shown in the two photos below:



Photo 3



Photo 2

The blueline stream previously mapped on USGS 7.5 Minute Quadrangle Topo Map dated 1971 is eliminated on the current USGS 7.5 Minute Quadrangle Topo Map. Appendix A, Exhibit D2 is the current USGS Blue Line Stream Designation Map for the area that shows no Blue Line Streams on site nor within the surrounding tributary watershed area.

Considering that the Mojave River tributary flows at this location are primarily underground within the sandy soil strata, empirical data was obtained to determine if the on-site permeable soils would also allow storm flows to confluence underground without any surface evidence.

C. No Evidence of Existing Off-Site Flows

To confirm this hypothesis, GeoTek, Inc performed an Infiltration Evaluation and tested six locations, three on site and three off-site at critical locations. The boring locations are shown as an excerpt from the GEOTEK Boring Location Map on the following Figure 1.

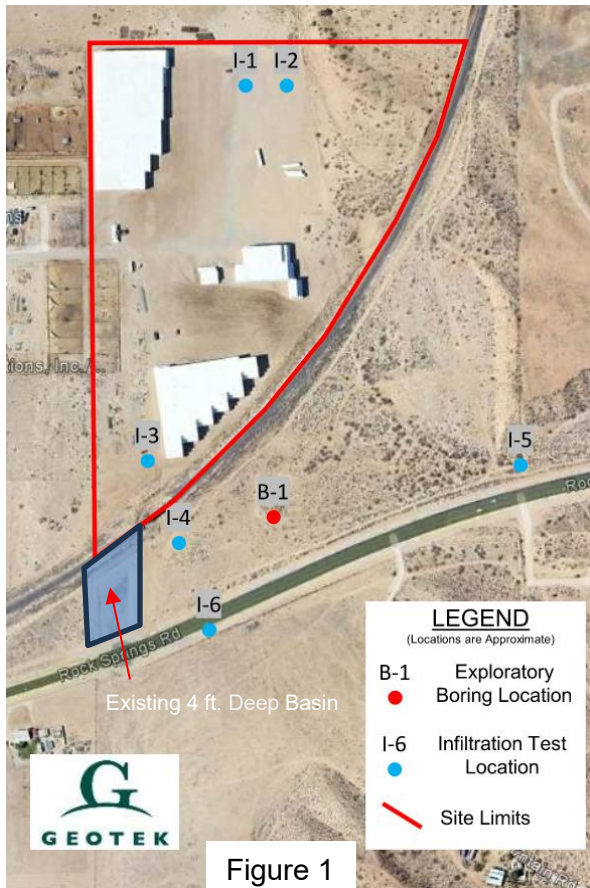


Figure 1

All but one infiltration test showed high percolation rates ranging from 9.39-inches per hour to 20.31 inches per hour. GEOTEK calculated the infiltration rate at Boring I-4 at 16.42 inches per hour. Thus, the four-foot-deep basin south of the property, next to percolation test I-4 shown in Figure 1 with a 16-inches/hour infiltration rate, drains in less than $(48/16.41)$ 2.92 hours. The GEOTEK Infiltration Report is included herewith as Appendix C.

An area, bounded by the BNSF Railroad on the north, Medford Way on the south, Deep Creek Road on the west, and the foothills on the east located south of the project site, is on average 1300 feet wide, 5400-foot long, and relatively flat consisting of the same sandy soil strata creating an infiltration area conveying the off-site flows across 153 acres of highly permeable soils (see Appendix A, Exhibit E4). This off-site area has a 24-acre shallow depression at the northerly end that collects these overall off-site flows via three drainage subareas shown on Appendix A, Exhibit E4, and conveys them as sheet flows as they approach the site from the south. No evidence of existing natural channelization is found which matches the conditions

on-site having a 700-foot-wide flat area that extends further west onto the neighboring parcels (see Section A-A on Exhibit F1).

Based on GEOTEK’s Infiltration Report for locations I-1 through I-4 the average infiltration rate is $(12.28+20.31+9.39+16.41)/4=14.55$ -inches per hour for this 153-acre infiltration area. Thus, this area can infiltrate $(153*14.55/12=)$ 186.51 ac-ft per hour or 15.46 ac-ft every 5 minutes. Given the fact that most of the storm flows enter from one side of the designated infiltration area, infiltration rates are assumed to be half or 7.73 ac-ft every five minutes.

Table 1 is an excerpt from the Off-Site Unit Hydrograph showing the 5-min incremental increase in volume (column 3) and the effects of the 7.73 infiltration (column 4) over the 5-min time periods. It was determined that prior to and after this 30-min peak flow time all 100-Year 24-Hour storm flows are infiltrated. During this 30-min peak time period (16.17 hr to 16.67 hr) 31.17 acre-feet of storm flow will be captured in the 24-acre depression with a depth of 1.3 feet which will infiltrate in less than 2-hours as the storm precipitation diminishes.

Table 1
Excerpt from Unit Hydrograph

T HRs.	Volume AF	t 5-min Increase	7.73 AF/t Infiltration Δ AF
16.17	224.18	8.26	0.53
16.25	236.36	12.18	4.45
16.33	254.8	18.44	10.71
16.42	271.59	16.79	9.06
16.50	283.9	12.31	4.58
16.58	293.25	9.35	1.62
16.67	301.2	7.95	0.22
16.75	308.15	6.95	
Total Non-Infiltrated Volume			31.17
24-Acre Depth			1.30

Based on this analysis, no off-site storm flows reach the southern end of the site. Therefore, we can conclude that off-site storm flows have not created channelization on the property and are not expected in the future. As such, the placement of the freight storage containers on-site will not restrict any off-site storm flows due to their non-existence.

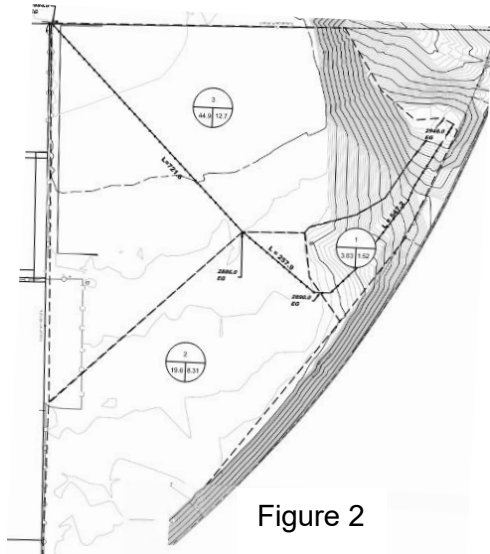


Figure 2

III. ON-SITE HYDROLOGY

A. On-site Pre-Developed Drainage description

Appendix A, Exhibit F2 shows the pre-developed site consists of a hill on the east, that drains south westerly to a level plain that slopes and conveys storm flows northwesterly towards the northern property line. The project is bounded on the south and east by the railroad that has a trellis undercrossing for storm flows at the southwest corner of the project. The site has been used for farming and ranching having little to no vegetation on the lower plateau that drains northwesterly at a grade of 0.4%.

B. On-site Pre-Developed Hydrology

The Project site was divided into three (3) sub areas (see Figure 2). Subarea one consists of 1.53-acres that generates 3.03 cfs as it travels southwesterly 547 feet to Sub area two (2) consisting of a 8.31-acre flat plain sloping northwesterly at 0.4% slope for 258 feet and generates a combined 19.6 cfs. This flow is conveyed northwesterly 721 feet along a 741 wide channel to become 44.9 cfs at the northern property line. As shown on Appendix A, Exhibit H2 the last conveyance has a time of concentration of 10.24 min and will flow at velocity of 0.642 fps at a depth of 0.11-feet.

Given that GEOTEK calculated the infiltration rate for Boring I-1 at 12.28 inches per hour, at a depth of 0.11 feet, the flows will percolate into the ground within $(0.11/12.23*0.60=)$ 0.54 minutes within $(0.54*60*0.642=)$ 20.78 lineal feet. Thus, in the pre-developed condition no stormwater leaves the site.

C. On-site Post Developed Condition and Hydrology

The post-developed site will not change any grading since the shipping containers placed on it are elevated 4-inches above ground to allow drainage to flow underneath. (See Appendix A, Exhibit G and Photo 4). Thus, the developed site maintains the three subareas established for the pre-developed site with a peak flow of 75 cfs at the end of the last conveyances having a time of concentration of 10.24 minutes flowing at a depth of 0.14-feet that will infiltrate within $(0.14/12.23*60=)$ 0.69 minutes.

Thus, in the post-developed condition no storm water leaves the site.



Photo 4

Considering that all developed storm flows will infiltrate within the 1st minute, there is no need for erosion control nor a Water Quality Management Plan infiltration basin.

IV. CONCLUSIONS

Considering the recent evidentiary empirical data from Post-Cyclone Tropical Storm Hilary and lack of surface evidence as observed by licensed professionals, and calculated confirmation of percolation rates after conducting percolation tests at six key locations, it has been demonstrated that no off-site flow will reach the project, and that on-site water from a 100-year storm will be completely infiltrated onsite, with no on-site flows leaving the property. Consequently, channelization or a basin for the 100-year storm event is not warranted given the stormwater will infiltrate in 0.69 minutes. The grading will not change, and historic drainage patterns will be maintained as percolated sheet flows. With the addition of shipping containers that are elevated above the calculated storm flow depths, the natural grade is maintained allowing the existing soil to continue absorbing any sheet flows. The intended continued use of the property will have no effect on the downstream properties.

On August 20th, 2023, observations during the above normal storm event produced from Tropical Storm Hilary established that the concentrated culvert flows conveyed through the pipe under Rock Springs Road to the southeast of the site, infiltrated into the existing sugar sands prior to reaching our site. Considering that the Mojave river floodplain is comprised of similar highly permeable sugar sands that allow major flows to disperse underground within the sandy soil strata, and the analysis performed as described herein, it is demonstrated that these off-site flows as well find permeable soils that allow them to confluence underground without any surface evidence.

Since no permanent structures are proposed protocols for FEMA FIRM Flood Zone D to elevate the pad (1) foot above the highest adjacent grade need not be applied.

In addition, since no grading of the site will be conducted, the following procedures and reports are deemed exempt and/ or not applicable:

- NPDES stormwater pollution prevention plan (SWPPP) and associated erosion control plans, best management practices (BMP's), water quality management plan (WQMP), and a design capture volume (Dcv) infiltration basin.
- Notice of intent to the state of California (NOI)
- Tribal grading observations

APPENDIX A

Exhibits:

Location Map – A

Soil Report – B

NOAA 14 PRECIPITATION DEPTHS – C1

Antecedent Moisture Condition – C2

FEMA & USGS – D1 & D2

Aquatic Resources Ephemeral and Streambed – E1 & E2

Off-Site Tributary Watershed – E3

Off-Site Tributary Subareas – E4

Pre-Developed Channelization and Hydrology Map – F1 & F2

Post-Developed Hydrology Plan – G

Conveyance Capacity Calculations - H1, H2, H3



APN:
0438-163-24

Latitude

34.418123

Longitude

-117.2202

DATE: 09/13/2022

DRAWN BY: DWL

CHECKED BY: DWL

SCALE: NTS

EXHIBIT A
LOCATION MAP
EARL GRAHAM CONTAINER STORAGE

APN: 0438-163-24



EXHIBIT B - SOIL REPORT

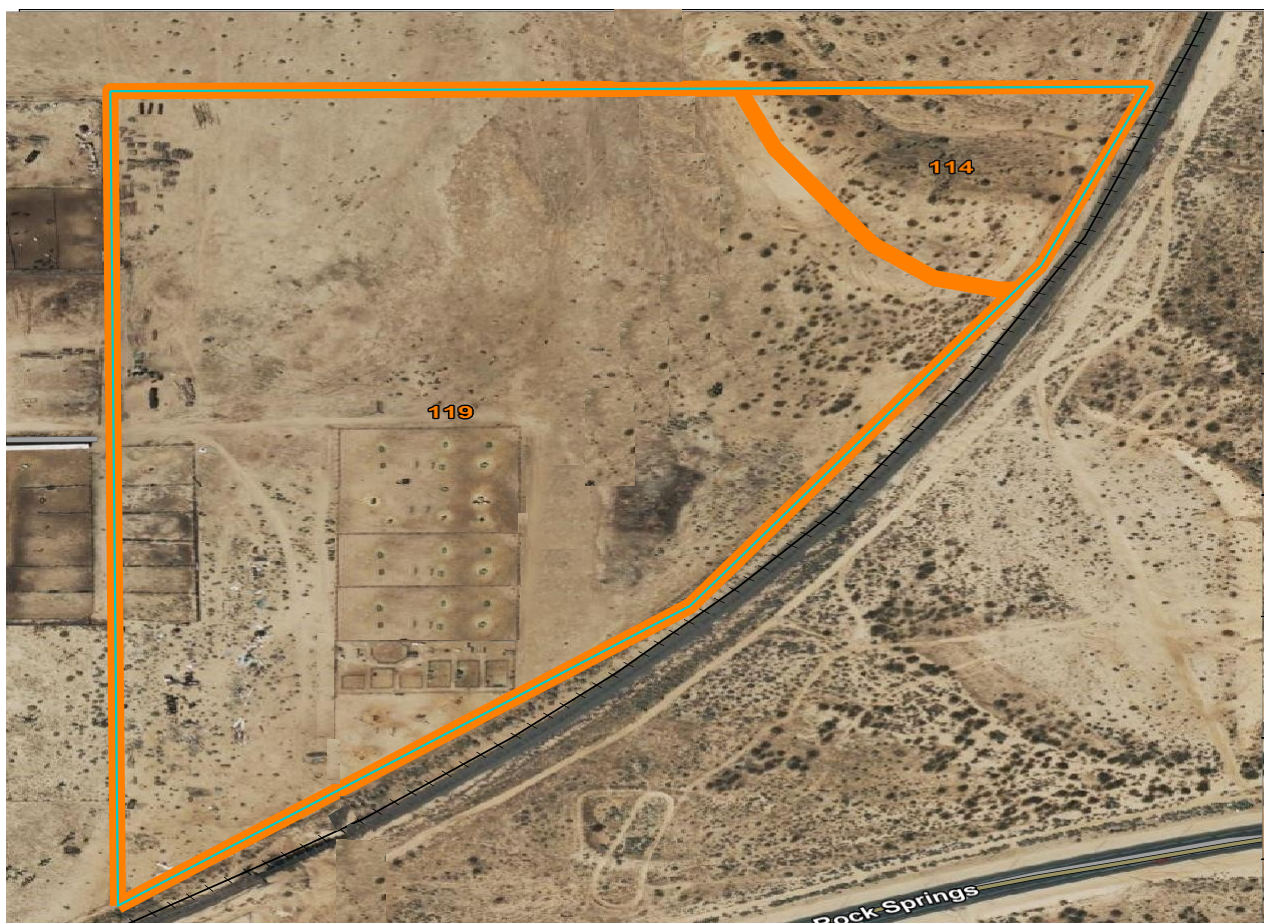


A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino County, California, Mojave River Area

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
114 SOIL GROUP A	CAJON SAND, 9 TO 15 PERCENT SLOPES	2.6	10.2%
119	CAJON-WASCO, COOL COMPLEX, 2 TO 9 PERCENT SLOPES*	22.5	89.8%
Totals for Area of Interest		25.1	100.0%



San Bernardino County, California, Mojave River Area

114—CAJON SAND, 9 TO 15 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkr1
Elevation: 1,800 to 4,000 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 180 to 290 days
Farmland classification: Not prime farmland

Map Unit Composition

Cajon, slope, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cajon, Slope

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 6 inches: sand
H2 - 6 to 42 inches: sand
H3 - 42 to 60 inches: gravelly sand

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Minor Components

Arizo

Percent of map unit: 5 percent
Hydric soil rating: No

Cajon, gravelly surface

Percent of map unit: 5 percent

Hydric soil rating: No

Cajon, steep

Percent of map unit: 5 percent

Hydric soil rating: No

119—CAJON-WASCO, COOL COMPLEX, 2 TO 9 PERCENT SLOPES*

Map Unit Setting

National map unit symbol: hkr

Elevation: 2,300 to 3,200 feet

Mean annual precipitation: 3 to 6 inches

Mean annual air temperature: 59 to 66 degrees F

Frost-free period: 180 to 290 days

Farmland classification: Not prime farmland

Map Unit Composition

Cajon and similar soils: 65 percent

Wasco, gravelly, and similar soils: 30 percent

Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cajon

Setting

Landform: Alluvial fans

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 8 inches: sand

H2 - 8 to 60 inches: sand

Properties and qualities

Slope: 2 to 9 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 1 percent

Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Custom Soil Resource Report

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Description of Wasco, Gravelly

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 60 inches: sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R030XF003CA - COARSE LOAMY
Hydric soil rating: No

Minor Components

Cajon, sloping

Percent of map unit: 2 percent
Hydric soil rating: No

Wasco

Percent of map unit: 2 percent
Hydric soil rating: No

Riverwash

Percent of map unit: 1 percent
Landform: Channels
Hydric soil rating: Yes



NOAA Atlas 14, Volume 6, Version 2
 Location name: Apple Valley, California, USA*
 Latitude: 34.4181°, Longitude: -117.2202°
 Elevation: 2888.62 ft**



* source: ESRI Maps
 ** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.085 (0.070-0.104)	0.118 (0.097-0.144)	0.163 (0.134-0.199)	0.201 (0.164-0.248)	0.255 (0.201-0.326)	0.299 (0.231-0.390)	0.345 (0.261-0.462)	0.394 (0.290-0.542)	0.464 (0.327-0.665)	0.519 (0.354-0.771)
10-min	0.122 (0.101-0.149)	0.169 (0.139-0.206)	0.233 (0.192-0.286)	0.287 (0.235-0.355)	0.365 (0.289-0.467)	0.428 (0.331-0.559)	0.495 (0.374-0.662)	0.565 (0.415-0.778)	0.665 (0.468-0.953)	0.744 (0.507-1.10)
15-min	0.147 (0.122-0.180)	0.204 (0.168-0.249)	0.282 (0.232-0.346)	0.348 (0.284-0.430)	0.442 (0.349-0.565)	0.518 (0.401-0.676)	0.598 (0.452-0.800)	0.684 (0.502-0.940)	0.804 (0.566-1.15)	0.900 (0.613-1.34)
30-min	0.208 (0.172-0.254)	0.287 (0.237-0.351)	0.397 (0.327-0.487)	0.489 (0.400-0.605)	0.622 (0.492-0.796)	0.729 (0.564-0.952)	0.843 (0.636-1.13)	0.963 (0.707-1.32)	1.13 (0.798-1.62)	1.27 (0.863-1.88)
60-min	0.270 (0.224-0.330)	0.374 (0.309-0.457)	0.517 (0.425-0.634)	0.637 (0.521-0.788)	0.811 (0.641-1.04)	0.950 (0.735-1.24)	1.10 (0.829-1.47)	1.25 (0.921-1.73)	1.48 (1.04-2.11)	1.65 (1.12-2.45)
2-hr	0.384 (0.318-0.469)	0.512 (0.423-0.626)	0.689 (0.567-0.845)	0.839 (0.685-1.04)	1.05 (0.832-1.35)	1.23 (0.948-1.60)	1.41 (1.06-1.88)	1.60 (1.17-2.20)	1.87 (1.32-2.68)	2.08 (1.42-3.09)
3-hr	0.471 (0.389-0.575)	0.620 (0.512-0.758)	0.825 (0.679-1.01)	1.00 (0.816-1.24)	1.25 (0.986-1.60)	1.45 (1.12-1.89)	1.66 (1.25-2.22)	1.88 (1.38-2.59)	2.19 (1.55-3.14)	2.44 (1.66-3.62)
6-hr	0.647 (0.535-0.791)	0.845 (0.698-1.03)	1.12 (0.919-1.37)	1.34 (1.10-1.66)	1.67 (1.32-2.13)	1.93 (1.49-2.52)	2.20 (1.66-2.94)	2.48 (1.82-3.42)	2.89 (2.03-4.14)	3.20 (2.18-4.75)
12-hr	0.834 (0.689-1.02)	1.11 (0.915-1.36)	1.48 (1.22-1.81)	1.79 (1.46-2.21)	2.22 (1.76-2.84)	2.56 (1.98-3.35)	2.92 (2.20-3.90)	3.29 (2.42-4.52)	3.80 (2.68-5.45)	4.20 (2.86-6.24)
24-hr	1.10 (0.975-1.27)	1.50 (1.33-1.73)	2.04 (1.80-2.35)	2.48 (2.17-2.89)	3.09 (2.62-3.72)	3.57 (2.96-4.39)	4.06 (3.29-5.12)	4.58 (3.61-5.93)	5.29 (4.00-7.14)	5.84 (4.27-8.16)
2-day	1.28 (1.14-1.48)	1.78 (1.58-2.05)	2.45 (2.17-2.83)	3.01 (2.63-3.50)	3.77 (3.19-4.54)	4.37 (3.62-5.37)	4.98 (4.04-6.28)	5.63 (4.43-7.29)	6.51 (4.92-8.79)	7.21 (5.27-10.1)
3-day	1.39 (1.23-1.59)	1.94 (1.72-2.24)	2.70 (2.38-3.12)	3.32 (2.91-3.87)	4.18 (3.54-5.03)	4.85 (4.03-5.96)	5.55 (4.49-6.99)	6.28 (4.95-8.13)	7.29 (5.51-9.83)	8.09 (5.91-11.3)
4-day	1.47 (1.30-1.69)	2.07 (1.83-2.39)	2.89 (2.55-3.34)	3.57 (3.12-4.15)	4.50 (3.81-5.42)	5.23 (4.34-6.43)	5.99 (4.85-7.55)	6.79 (5.35-8.79)	7.90 (5.97-10.7)	8.77 (6.41-12.2)
7-day	1.60 (1.42-1.84)	2.25 (1.99-2.59)	3.15 (2.78-3.64)	3.90 (3.42-4.55)	4.96 (4.20-5.97)	5.78 (4.80-7.11)	6.64 (5.38-8.36)	7.54 (5.94-9.76)	8.79 (6.64-11.9)	9.77 (7.14-13.6)
10-day	1.68 (1.49-1.94)	2.38 (2.11-2.74)	3.34 (2.95-3.86)	4.15 (3.63-4.83)	5.29 (4.48-6.37)	6.19 (5.14-7.61)	7.12 (5.77-8.97)	8.11 (6.39-10.5)	9.48 (7.17-12.8)	10.6 (7.72-14.8)
20-day	1.93 (1.71-2.22)	2.75 (2.44-3.17)	3.92 (3.46-4.53)	4.91 (4.30-5.72)	6.33 (5.36-7.62)	7.47 (6.20-9.18)	8.65 (7.01-10.9)	9.91 (7.81-12.8)	11.6 (8.81-15.7)	13.0 (9.52-18.2)
30-day	2.19 (1.94-2.52)	3.14 (2.78-3.61)	4.49 (3.96-5.19)	5.65 (4.95-6.58)	7.34 (6.22-8.83)	8.69 (7.21-10.7)	10.1 (8.18-12.7)	11.6 (9.14-15.0)	13.7 (10.3-18.5)	15.3 (11.2-21.4)
45-day	2.58 (2.29-2.97)	3.69 (3.27-4.26)	5.30 (4.68-6.12)	6.69 (5.86-7.80)	8.74 (7.40-10.5)	10.4 (8.63-12.8)	12.1 (9.84-15.3)	14.0 (11.0-18.1)	16.5 (12.5-22.3)	18.6 (13.6-25.9)
60-day	2.85 (2.52-3.27)	4.05 (3.59-4.67)	5.81 (5.13-6.72)	7.35 (6.44-8.57)	9.62 (8.15-11.6)	11.5 (9.53-14.1)	13.4 (10.9-16.9)	15.5 (12.2-20.1)	18.4 (13.9-24.9)	20.7 (15.1-28.9)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

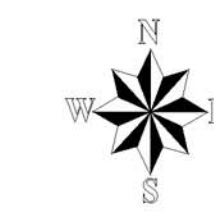
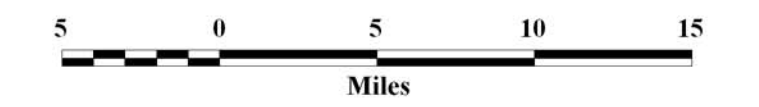
[Back to Top](#)

PF graphical

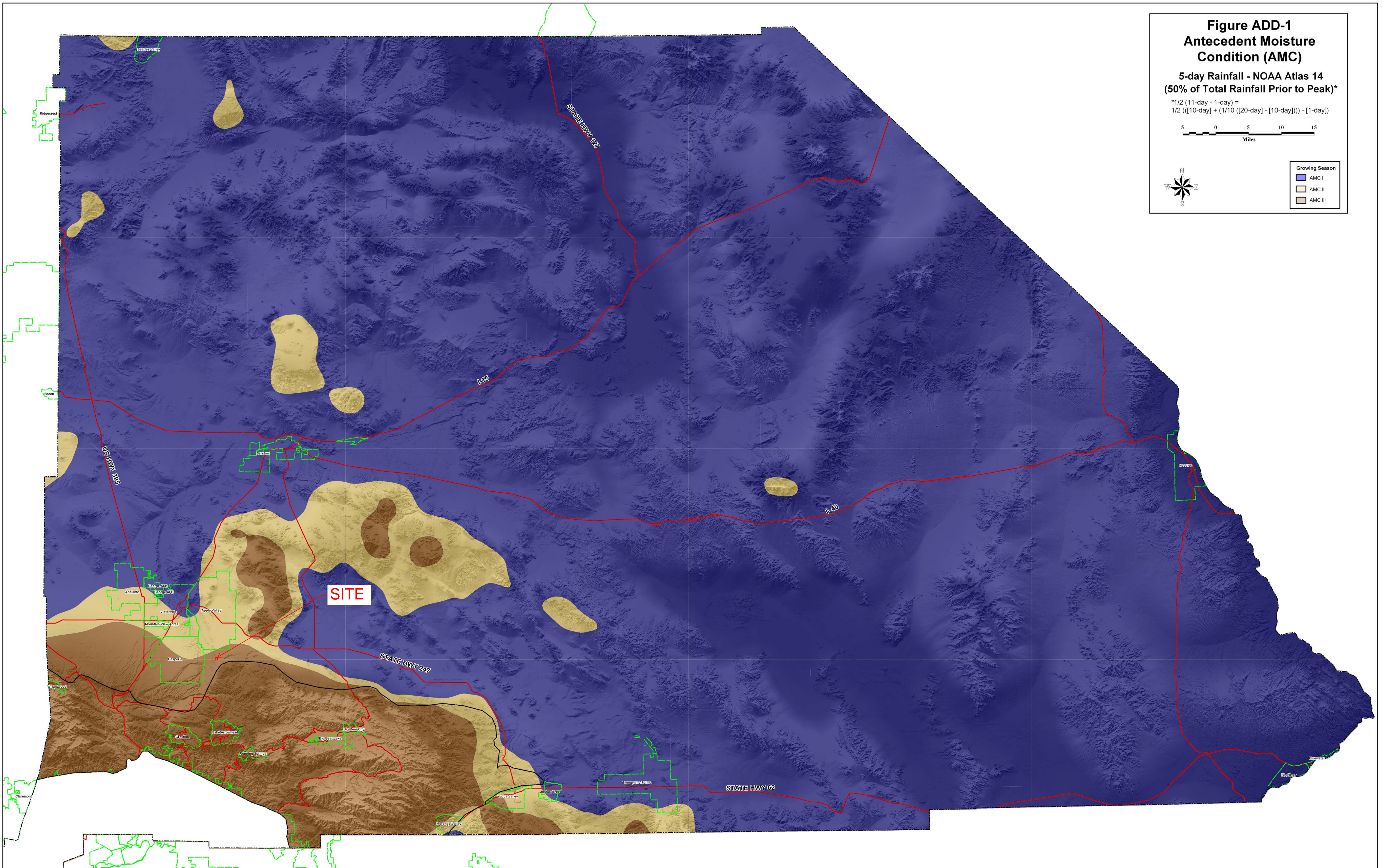
**Figure ADD-1
Antecedent Moisture
Condition (AMC)**

**5-day Rainfall - NOAA Atlas 14
(50% of Total Rainfall Prior to Peak)***

* $1/2 (11\text{-day} - 1\text{-day}) =$
 $1/2 ((10\text{-day}) + (1/10 ((20\text{-day}) - [10\text{-day}]))) - [1\text{-day}]$



Growing Season	
AMC I	Dark Blue
AMC II	Light Yellow
AMC III	Dark Brown

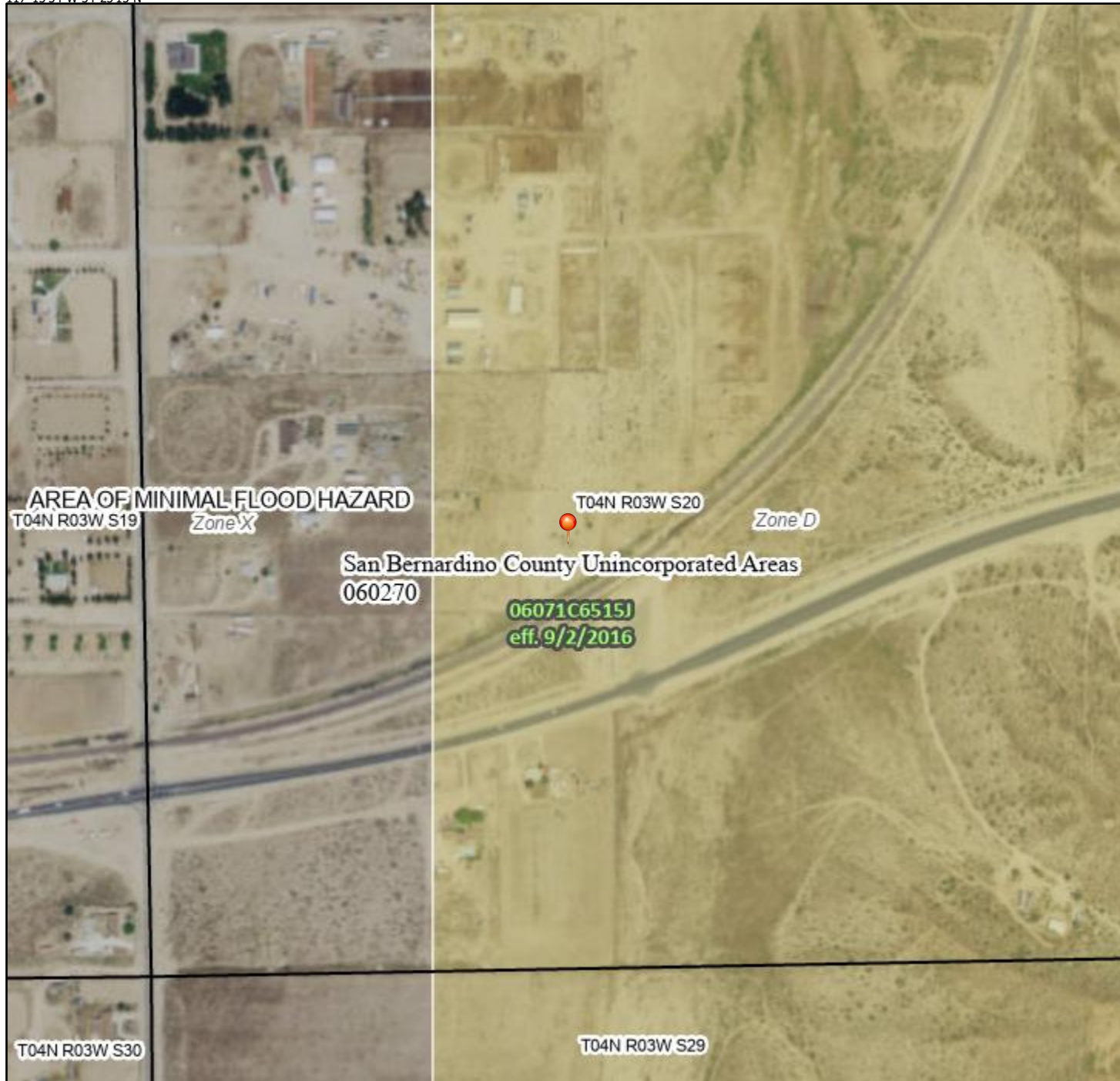


National Flood Hazard Layer FIRMette

EXHIBIT D 1



117°13'34"W 34°25'15"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

117°12'56"W 34°24'45"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i>
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
		Area of Undetermined Flood Hazard <i>Zone D</i>
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

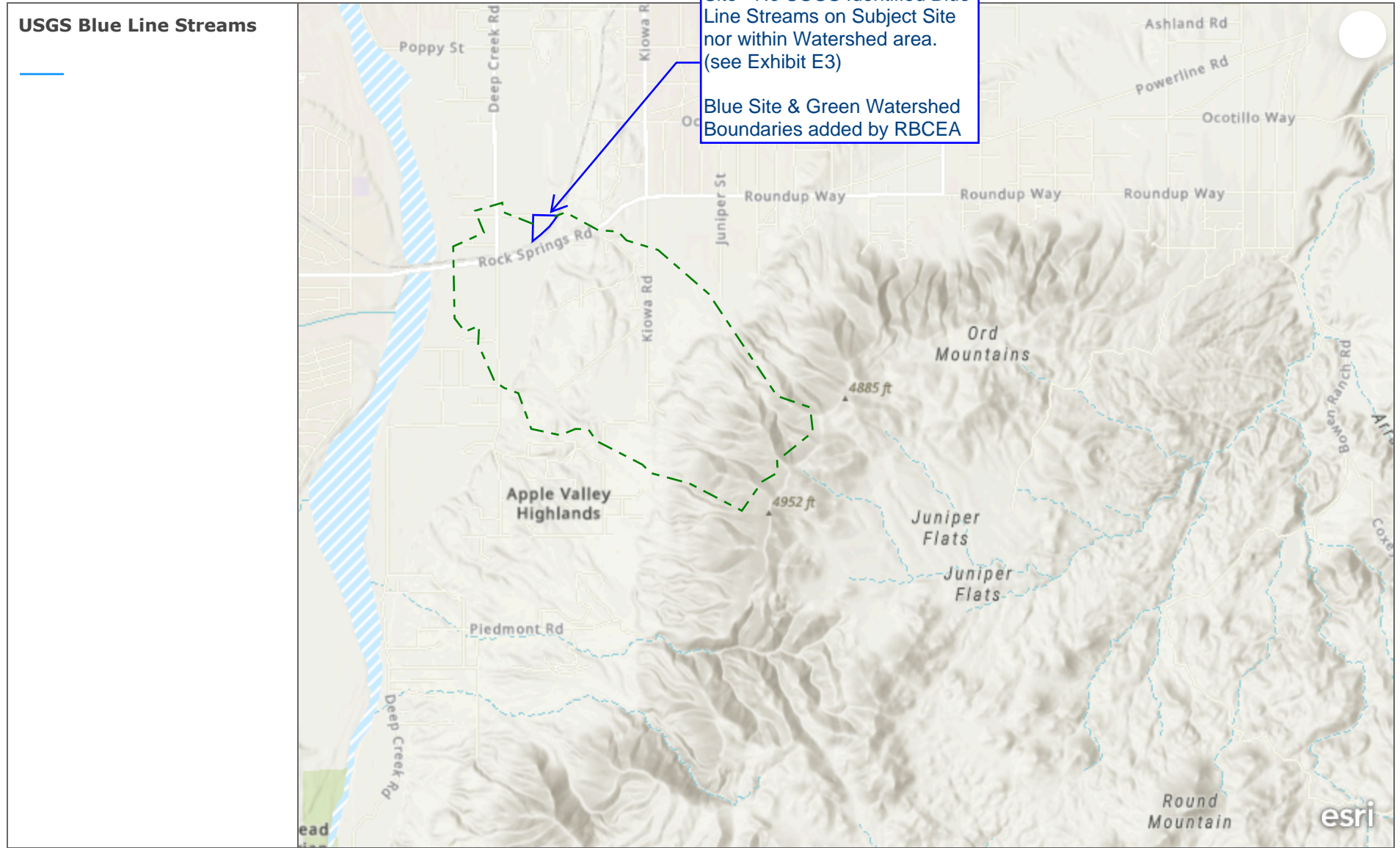
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **9/13/2022 at 11:28 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

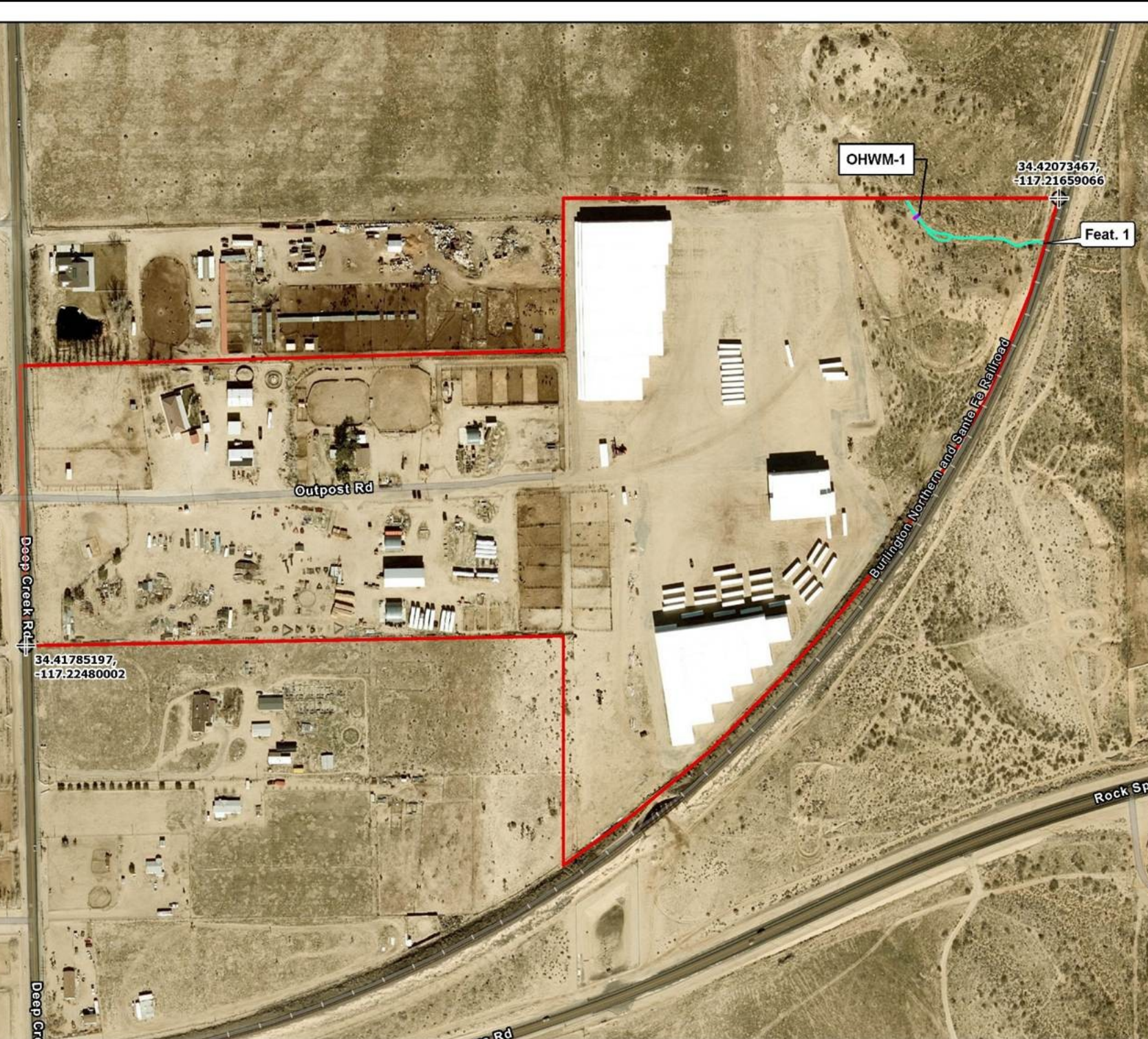
USGS Blue Line Streams

EXHIBIT D2



USGS Blue Line Streams

1mi



- Map Contents**
- Study Area - 47.10 ac.
 - OHWM Cross-section
 - Reference Coordinates
- Aquatic resources**
- Ephemeral Drainage - 0.050 ac.

EXHIBIT E1

Photo Source: County of San Bernardino (2023)
 Boundary Source: Red Brick Consulting
 Delineator(s): Chelsie Brown and Eliza McLean
 Coordinate System: NAD 1983 StatePlane California V FIPS 0405

¹ Subject to U.S. Army Corps of Engineers verification. This exhibit depicts information in accordance with the wetland delineation methods described in the 1987 Corps of Engineers Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual, Version 2.0, as well as the Updated Map and Drawing Standards for the South Pacific Region as amended on February 10, 2016, and conforms to Los Angeles District special feature boundaries have not been legally surveyed and may be subject to minor adjustments if required.
² The acreage value for each feature has been rounded to the nearest 1/1000 decimal. Values may not equal the total potential Waters of the U.S. acreage reported.

Sources: ESRI
 Other Related Info if Needed

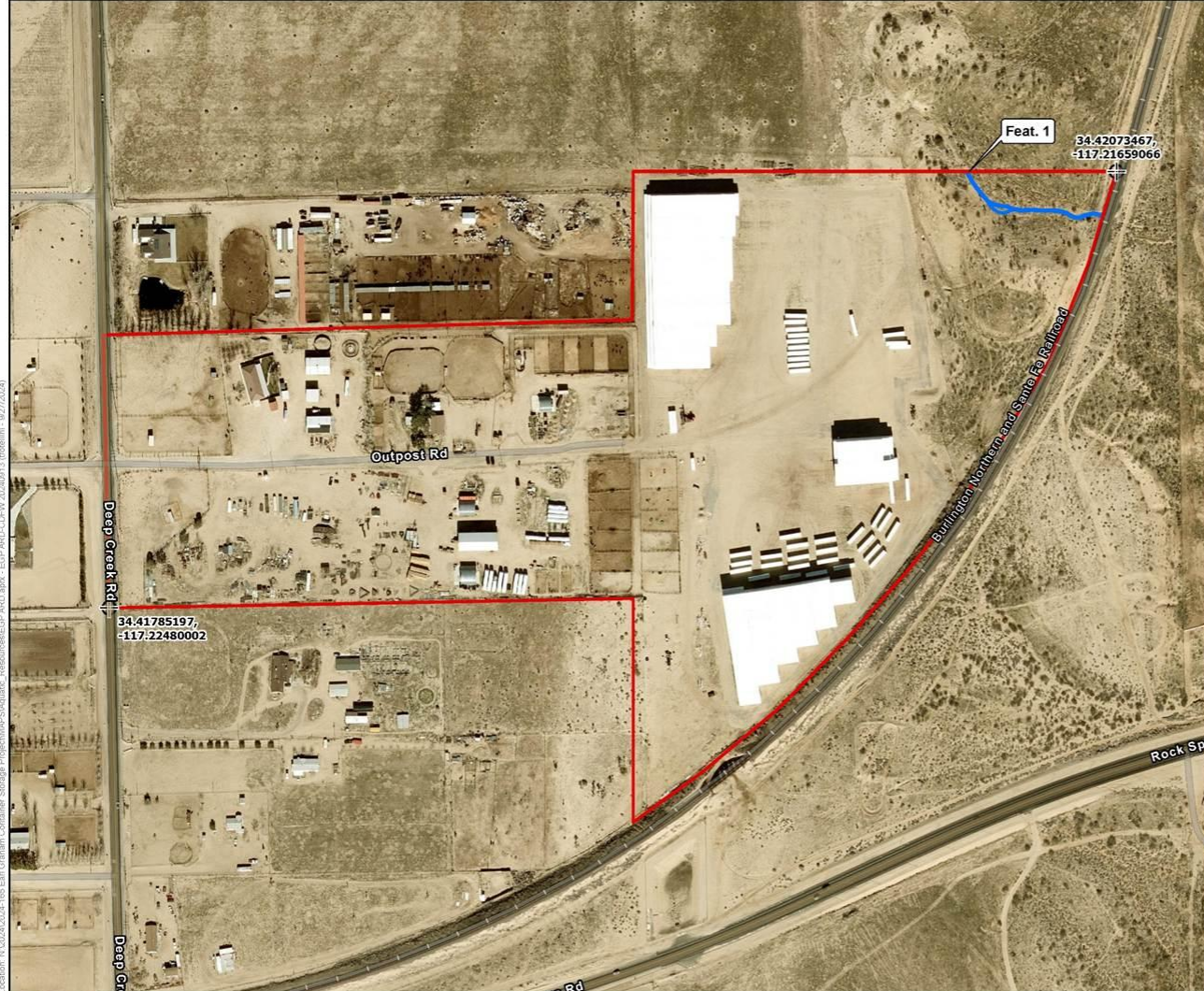


Map Date: 9/27/2024



Figure 4. Aquatic Resources Delineation

Location: N:\2024\2024-165_Earl_Graham_Container_Storage_Project\MAPS\Aquatic_Resources\EGP_ARD\CDFW_20240913_10a.mxd - 9/27/2024



Map Contents

- Study Area - 47.10 ac.
- Reference Coordinates
- Aquatic Resources**
- Streambed - 0.097 ac.

EXHIBIT E2

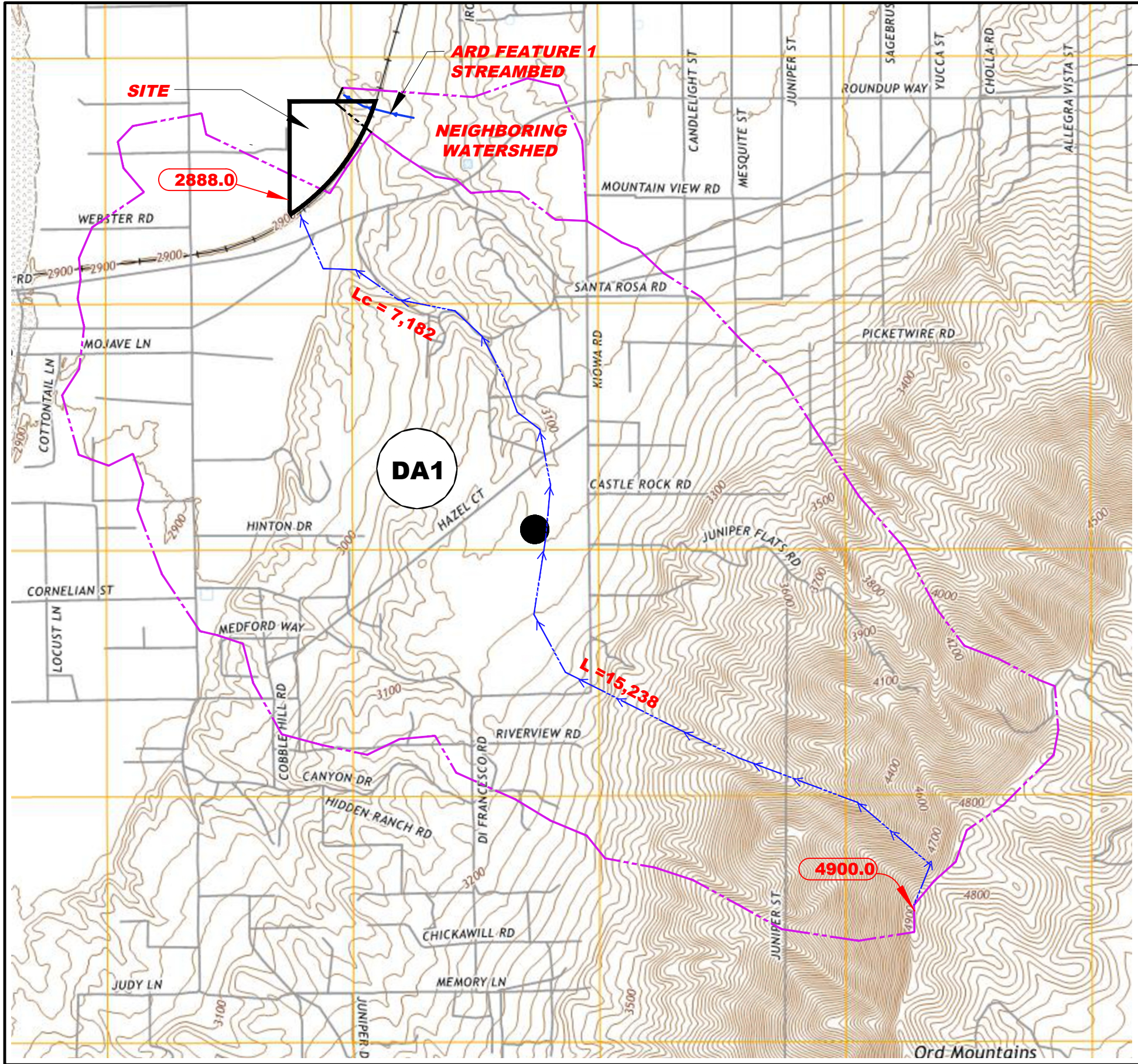
Sources: ESRI, County of San Bernardino (2023)
Other Related Info: if needed



Map Date: 9/27/2024



Figure 5. Aquatic Resources Delineation - CDFW



LEGEND:

- DA1 DRAINAGE AREA
- - - - - WATERSHED BOUNDRY
- - - - - LONGEST FLOWLINE
 $L_c = 7,182$
 $L = 15,238$
 $A = 1,902$ ACRES
- 2888.0 SPOT ELEVATION

HYDROLOGY STUDY

UNIT HYDROGRAPH

OFF-SITE WATERSHED

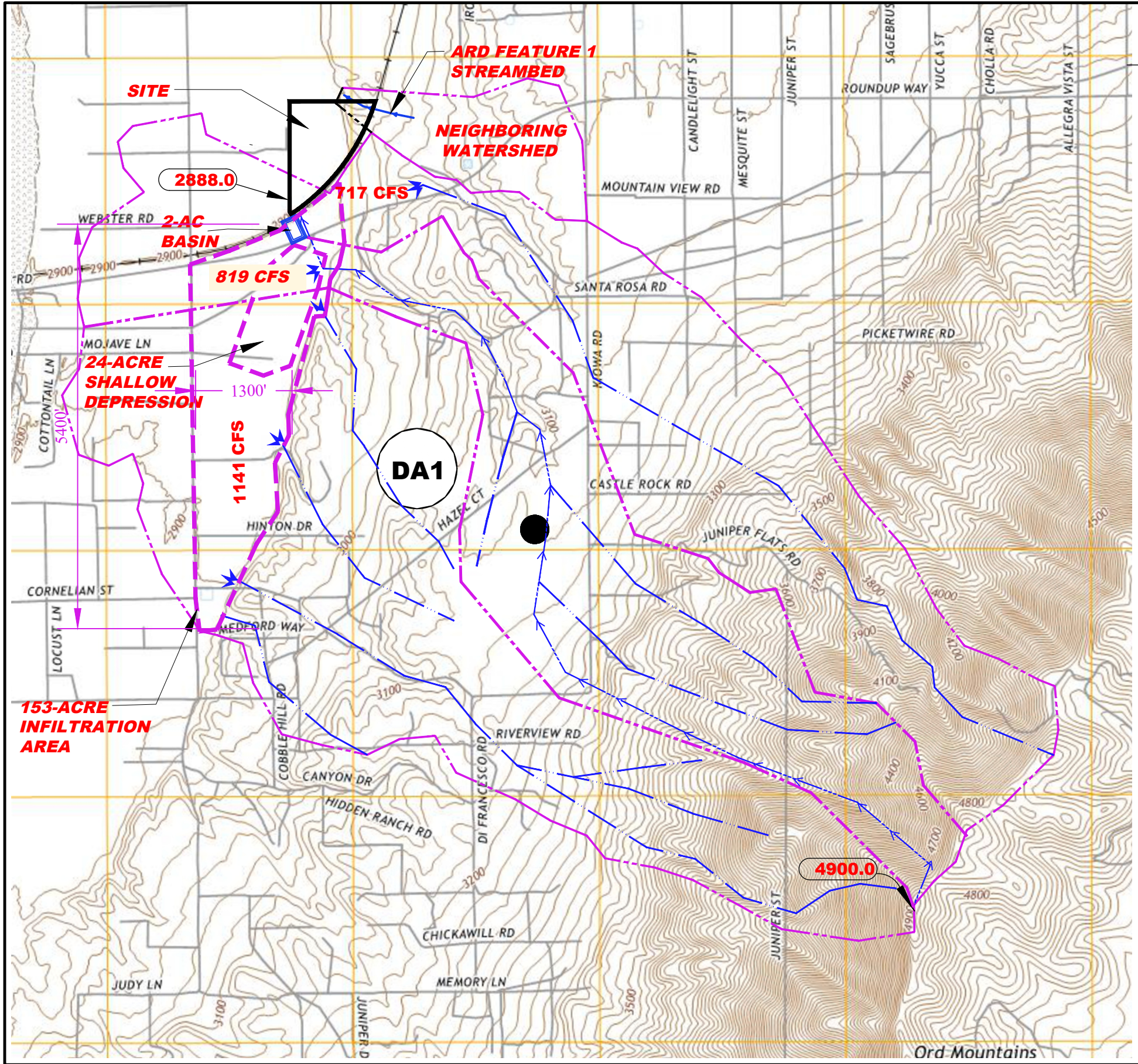
FOR:
**EARL GRAHAM
 CONTAINER
 STORAGE**

IN THE:
**CITY OF HESPERIA,
 CA**

APN:
0438-163-24

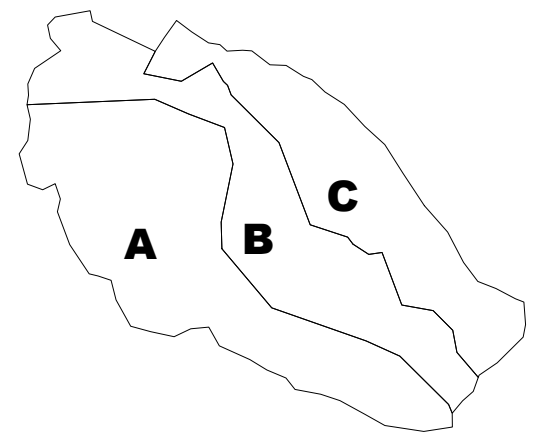
**RED
 BRICK**
 CONSULTING
 ENGINEERS & ARCHITECTS

EXHIBIT E3



SUBAREAS

- DA1** DRAINAGE AREA
- WATERSHED BOUNDRY
- LONGEST FLOWLINE
- SUBAREA FLOWLINE



Subarea	Area Ac	Area %	%Q cfs
A	811	43%	1141
B	582	31%	819
C	509	27%	717
Total	1902		2678

HYDROLOGY STUDY

OFF-SITE WATERSHED TRIBUTARY AREAS

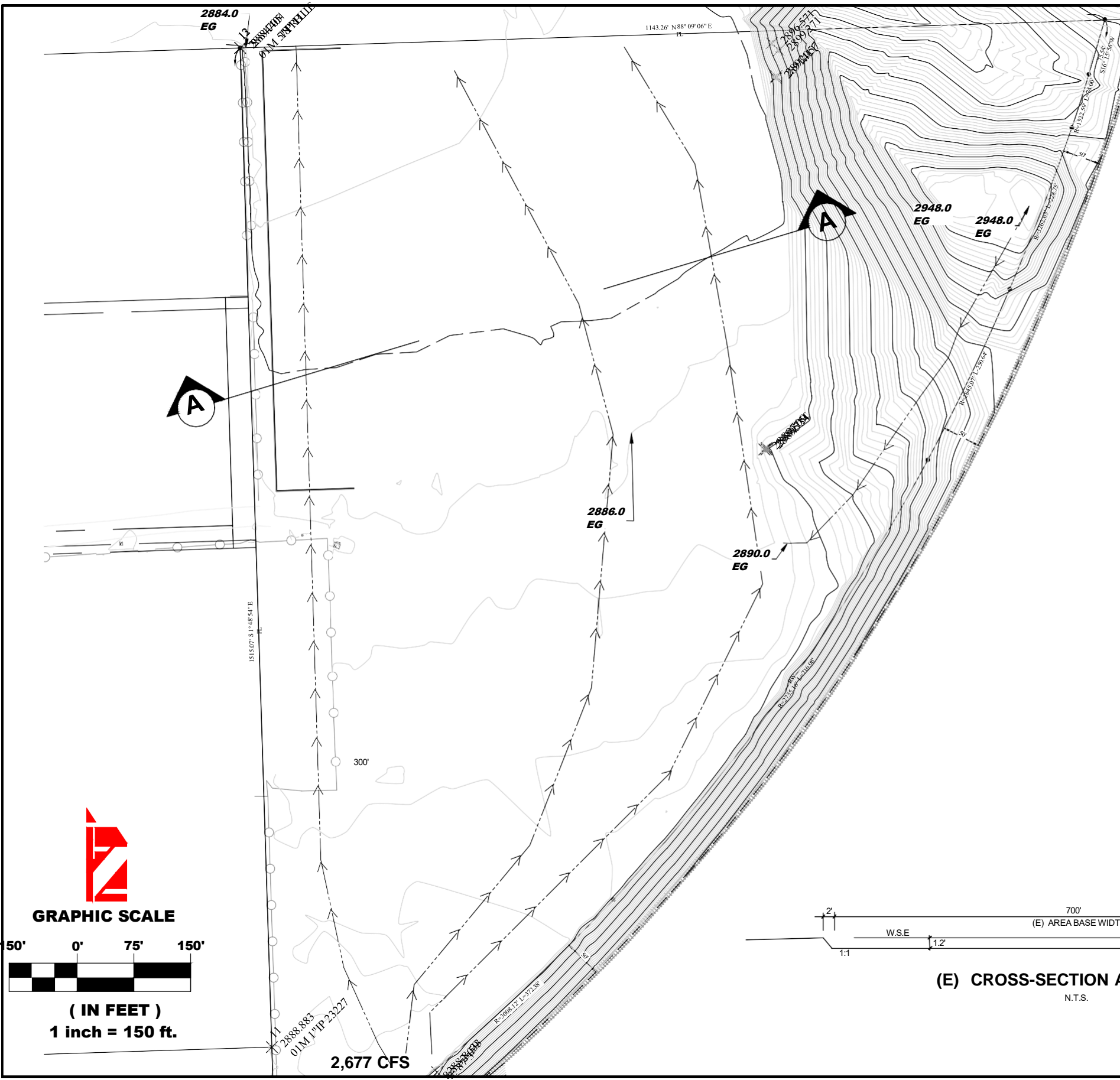
**FOR:
EARL GRAHAM
CONTAINER
STORAGE**

**IN THE:
CITY OF HESPERIA,
CA**

**APN:
0438-163-24**

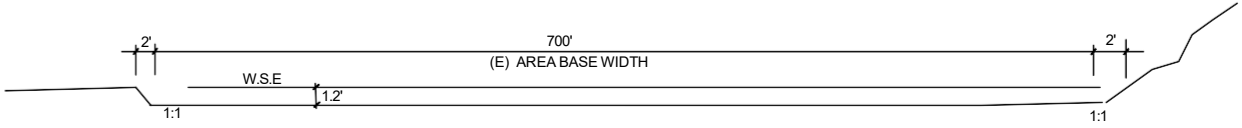
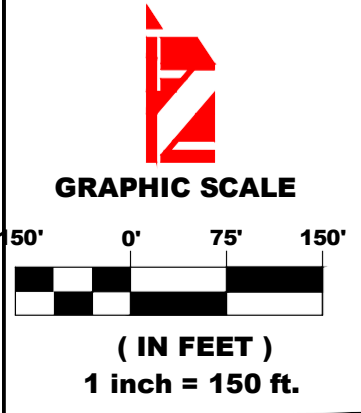
**RED
BRICK
CONSULTING**
ENGINEERS & ARCHITECTS

EXHIBIT E4



LEGEND:

- TRIBUTARY DRAINAGE AREA
- SUBAREA BOUNDARY
- SUBAREA FLOWLINE
- PROPERTY LINE
- ## CONVEYANCE
- 96.40 TC SPOT ELEVATION
- EG EXISTING GRADE
- FG FINISH GRADE
- FS FINISH SURFACE
- FF FINISH FLOOR
- IE INVERT ELEVATION
- TC TOP OF CONCRETE



HYDROLOGY STUDY

PRE-DEVELOPED CONDITION

2,677 CFS ON-SITE CHANNEL

FOR: EARL GRAHAM CONTAINER STORAGE

APN: 0438-163-24

RED BRICK CONSULTING ENGINEERS & ARCHITECTS

EXHIBIT F1



LEGEND:

- DRAINAGE SUB-AREA OR LOCATION

TRIBUTARY AREA (AC)
- Q25(cfs)
- TRIBUTARY DRAINAGE AREA

----- SUBAREA BOUNDARY

←----- SUBAREA FLOWLINE

----- PROPERTY LINE
- ## CONVEYANCE
- 96.40 SPOT ELEVATION

TC
- EG EXISTING GRADE

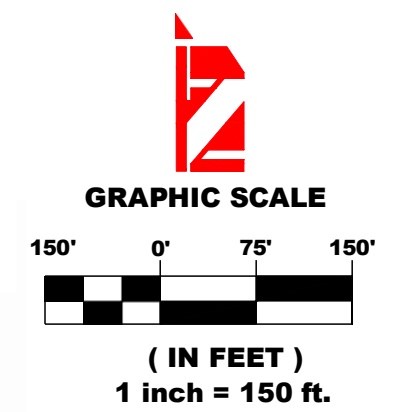
FG FINISH GRADE

FS FINISH SURFACE

FF FINISH FLOOR

IE INVERT ELEVATION

TC TOP OF CONCRETE



HYDROLOGY STUDY

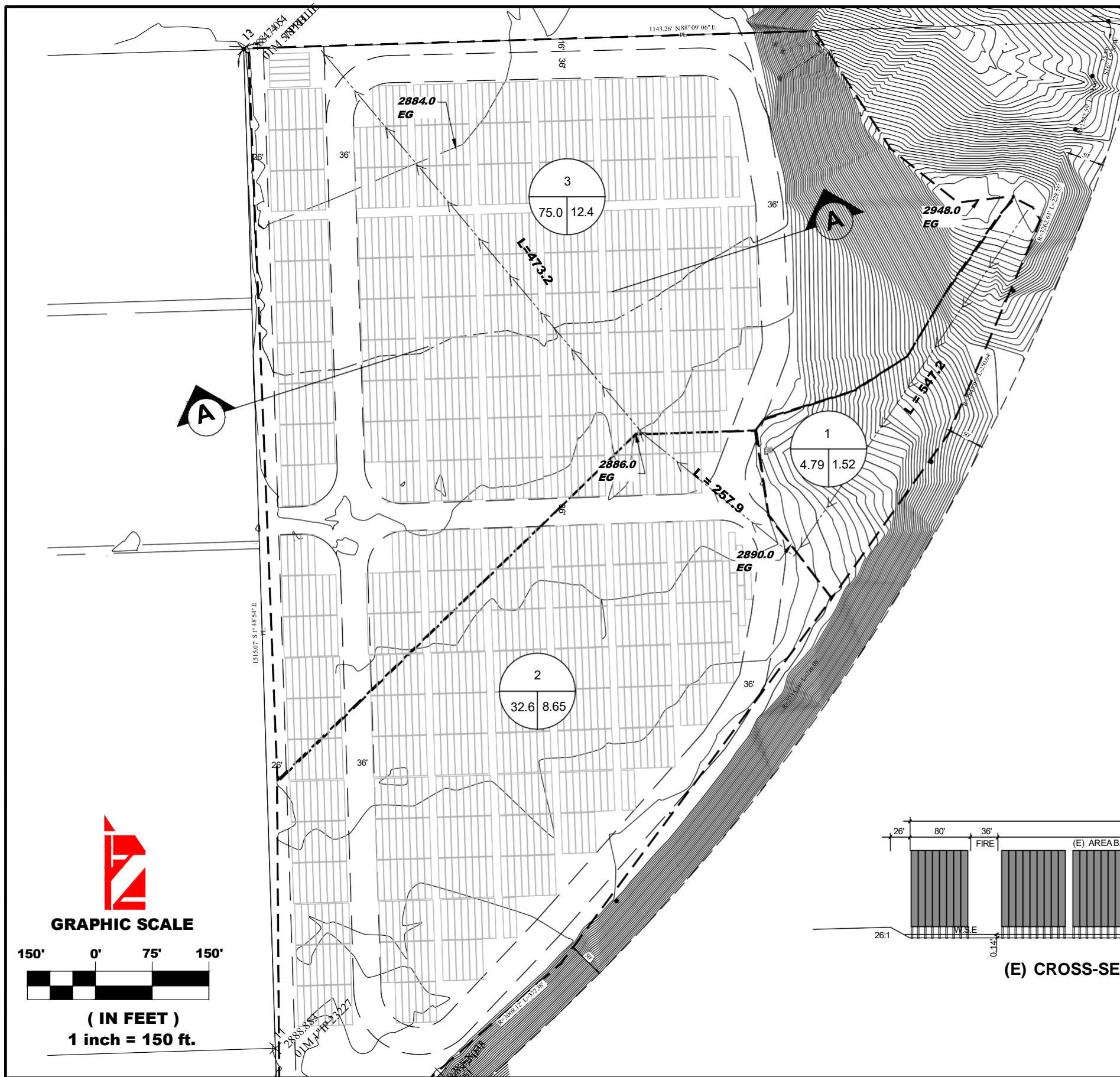
PRE-DEVELOPED CONDITION

**FOR:
EARL GRAHAM
CONTAINER
STORAGE**

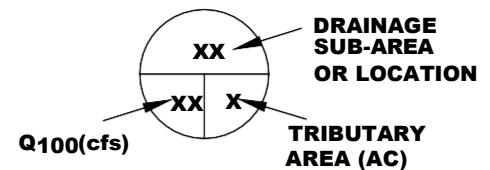
**APN:
0438-163-24**



EXHIBIT F2

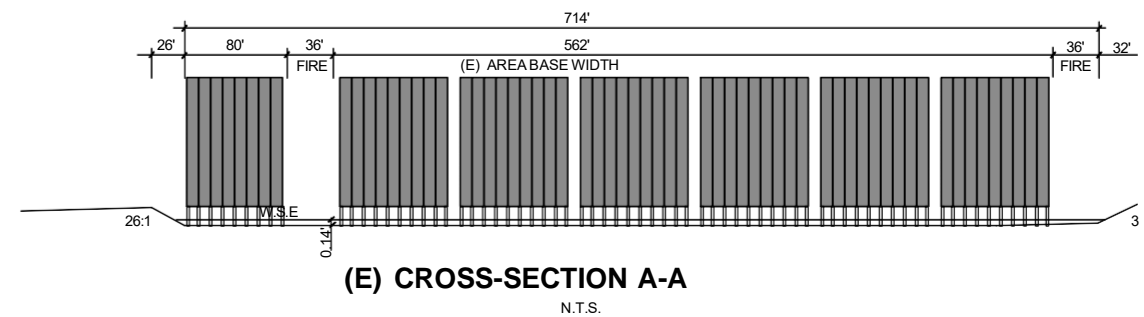
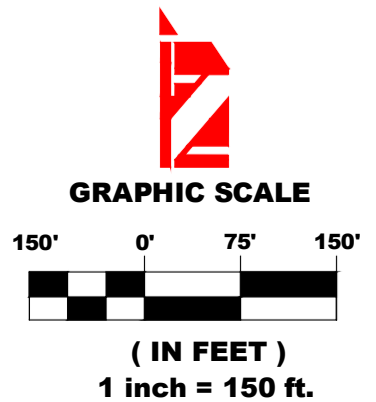


LEGEND:



- TRIBUTARY DRAINAGE AREA
- - - - - SUBAREA BOUNDARY
- - - - - SUBAREA FLOWLINE
- - - - - PROPERTY LINE

- (##) CONVEYANCE
- EG SPOT ELEVATION
- FG FINISH GRADE
- FS FINISH SURFACE
- FF FINISH FLOOR
- IE INVERT ELEVATION
- TC TOP OF CONCRETE



HYDROLOGY STUDY

POST-DEVELOPED CONDITION

**FOR:
EARL GRAHAM
CONTAINER STORAGE**

**APN:
0438-163-24**

**RED
BRICK
CONSULTING
ENGINEERS & ARCHITECTS**

EXHIBIT G

2,667 CFS OFF-SITE
NATURAL STORM FLOW
CONVEYANCE CAPACITY
CALCULATION
(SHEET-FLOW)

```

*** |<----- (781.72') ----->| ***
***^^^^^^^^^ Water Depth ( 1.17') ^^^^^^^^^***
***                                     ***
***                                     ***
***                                     ***
*** |<----- (714.00') ----->| ***
*****
*****

```

Trapezoidal

Flowrate	2,677.000	CFS
Velocity	3.066	fps
Depth of Flow	1.168	feet
Critical Depth	0.749	feet
Freeboard	0.000	feet
Total Depth	1.168	feet
Width at Water Surface	781.718	feet
Top Width	781.718	feet
Slope of Channel	0.400	%
Left Side Slope	26.000	: 1
Right Side Slope	32.000	: 1
Base Width	714.000	feet
X-Sectional Area	873.166	sq. ft.
Wetted Perimeter	781.759	feet
AR^(2/3)	939.968	
Mannings 'n'	0.033	

DATE: 09/13/2022
DRAWN BY: DWL
CHECKED BY: DWL
SCALE: NTS

EXHIBIT H1
OFF-SITE CONVEYANCE
EARL GRAHAM CONTAINER STORAGE
APN: 0438-163-24



25-YEAR
714-FT WIDE ON-SITE
NATURAL STORM FLOW
CONVEYANCE CAPACITY
CALULATION
(SHEET-FLOW)

```

*** |<----- (720.23') ----->| ***
***^^^^^^^ Water Depth ( 0.11') ^^^^^^***
***                                     ***
***                                     ***
***                                     ***
*** |<----- (714.00') ----->| ***
*****
*****

```

Trapezoidal

Flowrate	49.468	CFS
Velocity	0.642	fps
Depth of Flow	0.107	feet
Critical Depth	0.053	feet
Freeboard	0.000	feet
Total Depth	0.107	feet
Width at Water Surface	720.233	feet
Top Width	720.233	feet
Slope of Channel	0.400	%
Left Side Slope	26.000	: 1
Right Side Slope	32.000	: 1
Base Width	714.000	feet
X-Sectional Area	77.063	sq. ft.
Wetted Perimeter	720.237	feet
AR^(2/3)	17.369	
Mannings 'n'	0.033	

DATE: 09/13/2022
DRAWN BY: DWL
CHECKED BY: DWL
SCALE: NTS

EXHIBIT H2
ON-SITE CONVEYANCE
EARL GRAHAM CONTAINER STORAGE
APN: 0438-163-24



100-YEAR
714-FT WIDE ON-SITE NATURAL
STORM FLOW
CONVEYANCE CAPACITY
CALCULATION
(SHEET-FLOW)

```

*** |<----- (722.00') ----->| ***
***^^^^^^^^ Water Depth ( 0.14') ^^^^^^^^^***
***                                     ***
***                                     ***
***                                     ***
***                                     ***
*** |<----- (714.00') ----->| ***
*****
*****

```

Trapezoidal

Flowrate	75.000	CFS
Velocity	0.757	fps
Depth of Flow	0.138	feet
Critical Depth	0.074	feet
Freeboard	0.000	feet
Total Depth	0.138	feet
Width at Water Surface	721.999	feet
Top Width	721.999	feet
Slope of Channel	0.400	%
Left Side Slope	26.000	: 1
Right Side Slope	32.000	: 1
Base Width	714.000	feet
X-Sectional Area	99.024	sq. ft.
Wetted Perimeter	722.004	feet
AR^(2/3)	26.336	
Mannings 'n'	0.033	

DATE: 09/13/2022
DRAWN BY: DWL
CHECKED BY: DWL
SCALE: NTS

EXHIBIT H3
ON-SITE CONVEYANCE
EARL GRAHAM CONTAINER STORAGE
APN: 0438-163-24



APPENDIX B

Hydrology:

Off-Site 1902-Ac 100-Year Unit Hydrograph Method 24-Hour

On-Site Pre-Developed 25-Year 1-Hour Storm

On-Site Post-Developed 100-Year 1-Hour Storm

On-Site Post-Developed 100-Year 24-Hour Unit Hydrograph



U n i t H y d r o g r a p h A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018, Version 9.0

Study date 11/09/22

+++++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6434

**1902-ACRE OFF-SITE DRAINAGE
24-HOUR**

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
1902.00	1	1.10

Rainfall data for year 100		
1902.00	6	2.20

Rainfall data for year 100		
1902.00	24	4.06

+++++

***** Area-averaged max loss rate, Fm *****

SCS curve No. (AMCII)	SCS curve NO. (AMC 3)	Area (Ac.)	Area Fraction	Fp (Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
67.0	84.6	1902.00	1.000	0.290	0.900	0.261

Area-averaged adjusted loss rate Fm (In/Hr) = 0.261

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC3)	S	Pervious Yield Fr
1711.80	0.900	67.0	84.6	1.82	0.610
190.20	0.100	98.0	98.0	0.20	0.942

Area-averaged catchment yield fraction, Y = 0.643
Area-averaged low loss fraction, Yb = 0.357
+++++

Watercourse length = 15238.00(Ft.)
Length from concentration point to centroid = 7182.00(Ft.)
Elevation difference along watercourse = 2012.00(Ft.)
Mannings friction factor along watercourse = 0.033
Watershed area = 1902.00(Ac.)
Catchment Lag time = 0.384 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 21.7092
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.261(In/Hr)
Average low loss rate fraction (Yb) = 0.357 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.522(In)
Computed peak 30-minute rainfall = 0.893(In)
Specified peak 1-hour rainfall = 1.100(In)
Computed peak 3-hour rainfall = 1.683(In)
Specified peak 6-hour rainfall = 2.200(In)
Specified peak 24-hour rainfall = 4.060(In)

Rainfall depth area reduction factors:
Using a total area of 1902.00(Ac.) (Ref: fig. E-4)

5-minute factor = 0.911	Adjusted rainfall = 0.475(In)
30-minute factor = 0.911	Adjusted rainfall = 0.814(In)
1-hour factor = 0.911	Adjusted rainfall = 1.002(In)
3-hour factor = 0.989	Adjusted rainfall = 1.664(In)
6-hour factor = 0.994	Adjusted rainfall = 2.187(In)
24-hour factor = 0.998	Adjusted rainfall = 4.050(In)

U n i t H y d r o g r a p h

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Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)

	(K =	23002.31 (CFS))
1	1.111	255.663
2	5.167	932.809
3	13.599	1939.614
4	31.763	4178.253
5	48.318	3807.996
6	59.055	2469.673
7	66.093	1618.852
8	71.461	1234.930
9	75.664	966.789
10	79.106	791.539
11	81.884	639.006
12	84.232	540.240
13	86.332	482.943
14	88.139	415.651
15	89.587	333.107
16	90.844	289.051
17	91.992	264.252

18	93.013	234.725
19	93.935	212.224
20	94.693	174.301
21	95.425	168.311
22	96.035	140.437
23	96.600	129.834
24	97.083	111.108
25	97.474	89.905
26	97.826	81.050
27	98.053	52.177
28	98.273	50.590
29	98.525	57.890
30	98.785	59.923
31	99.046	59.923
32	99.306	59.923
33	99.531	51.728
34	99.670	32.068
35	99.806	31.210
36	100.000	15.605

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.4754	0.4754
2	0.5853	0.1099
3	0.6610	0.0757
4	0.7206	0.0596
5	0.7705	0.0499
6	0.8138	0.0433
7	0.8523	0.0385
8	0.8872	0.0348
9	0.9191	0.0319
10	0.9486	0.0295
11	0.9761	0.0275
12	1.0019	0.0258
13	1.0396	0.0377
14	1.0758	0.0362
15	1.1106	0.0348
16	1.1442	0.0336
17	1.1767	0.0325
18	1.2081	0.0315
19	1.2386	0.0305
20	1.2683	0.0297
21	1.2972	0.0289
22	1.3253	0.0282
23	1.3528	0.0275
24	1.3796	0.0268
25	1.4059	0.0262
26	1.4316	0.0257
27	1.4567	0.0252
28	1.4814	0.0247
29	1.5056	0.0242
30	1.5293	0.0237
31	1.5526	0.0233
32	1.5755	0.0229
33	1.5981	0.0225
34	1.6202	0.0222
35	1.6421	0.0218
36	1.6636	0.0215
37	1.6816	0.0181
38	1.6994	0.0178
39	1.7169	0.0175
40	1.7342	0.0172
41	1.7512	0.0170

253	0.0081	0.0029	0.0052
254	0.0080	0.0029	0.0052
255	0.0080	0.0028	0.0051
256	0.0079	0.0028	0.0051
257	0.0078	0.0028	0.0050
258	0.0078	0.0028	0.0050
259	0.0077	0.0027	0.0049
260	0.0076	0.0027	0.0049
261	0.0076	0.0027	0.0049
262	0.0075	0.0027	0.0048
263	0.0074	0.0027	0.0048
264	0.0074	0.0026	0.0047
265	0.0073	0.0026	0.0047
266	0.0073	0.0026	0.0047
267	0.0072	0.0026	0.0046
268	0.0072	0.0026	0.0046
269	0.0071	0.0025	0.0046
270	0.0071	0.0025	0.0045
271	0.0070	0.0025	0.0045
272	0.0070	0.0025	0.0045
273	0.0069	0.0025	0.0044
274	0.0069	0.0024	0.0044
275	0.0068	0.0024	0.0044
276	0.0068	0.0024	0.0044
277	0.0067	0.0024	0.0043
278	0.0067	0.0024	0.0043
279	0.0066	0.0024	0.0043
280	0.0066	0.0024	0.0042
281	0.0066	0.0023	0.0042
282	0.0065	0.0023	0.0042
283	0.0065	0.0023	0.0042
284	0.0064	0.0023	0.0041
285	0.0064	0.0023	0.0041
286	0.0064	0.0023	0.0041
287	0.0063	0.0023	0.0041
288	0.0063	0.0022	0.0040

Total soil rain loss = 1.27(In)
Total effective rainfall = 2.78(In)
Peak flow rate in flood hydrograph = 2677.48(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	675.0	1350.0	2025.0	2700.0
0+ 5	0.0071	1.03	Q				
0+10	0.0400	4.79	Q				
0+15	0.1268	12.60	Q				
0+20	0.3297	29.45	Q				
0+25	0.6386	44.86	Q				
0+30	1.0169	54.92	Q				
0+35	1.4411	61.59	Q				
0+40	1.9008	66.75	Q				
0+45	2.3886	70.83	VQ				
0+50	2.8998	74.23	VQ				
0+55	3.4302	77.02	VQ				
1+ 0	3.9772	79.42	VQ				

1+ 5	4.5392	81.60	VQ				
1+10	5.1144	83.52	VQ				
1+15	5.7006	85.11	VQ				
1+20	6.2966	86.54	VQ				
1+25	6.9017	87.87	VQ				
1+30	7.5153	89.08	VQ				
1+35	8.1365	90.21	VQ				
1+40	8.7646	91.19	VQ				
1+45	9.3993	92.15	VQ				
1+50	10.0398	93.01	VQ				
1+55	10.6860	93.82	VQ				
2+ 0	11.3373	94.57	IQ				
2+ 5	11.9932	95.23	IQ				
2+10	12.6534	95.87	IQ				
2+15	13.3172	96.38	IQ				
2+20	13.9846	96.90	IQ				
2+25	14.6557	97.45	IQ				
2+30	15.3307	98.01	IQ				
2+35	16.0096	98.57	IQ				
2+40	16.6924	99.14	IQ				
2+45	17.3789	99.68	IQ				
2+50	18.0686	100.15	IQ				
2+55	18.7615	100.61	IQ				
3+ 0	19.4572	101.02	IQ				
3+ 5	20.1553	101.36	IQ				
3+10	20.8558	101.71	IQ				
3+15	21.5586	102.06	IQ				
3+20	22.2640	102.42	IQV				
3+25	22.9718	102.77	IQV				
3+30	23.6821	103.14	IQV				
3+35	24.3949	103.50	IQV				
3+40	25.1103	103.87	IQV				
3+45	25.8282	104.24	IQV				
3+50	26.5488	104.62	IQV				
3+55	27.2719	105.00	IQV				
4+ 0	27.9977	105.39	IQV				
4+ 5	28.7262	105.77	IQV				
4+10	29.4574	106.17	IQV				
4+15	30.1913	106.56	IQV				
4+20	30.9281	106.97	IQV				
4+25	31.6675	107.37	IQV				
4+30	32.4099	107.79	IQV				
4+35	33.1550	108.20	IQ V				
4+40	33.9031	108.62	IQ V				
4+45	34.6540	109.04	IQ V				
4+50	35.4079	109.47	IQ V				
4+55	36.1648	109.90	IQ V				
5+ 0	36.9247	110.34	IQ V				
5+ 5	37.6877	110.78	IQ V				
5+10	38.4537	111.23	IQ V				
5+15	39.2229	111.68	IQ V				
5+20	39.9952	112.14	IQ V				
5+25	40.7707	112.60	IQ V				
5+30	41.5494	113.07	IQ V				
5+35	42.3314	113.54	IQ V				
5+40	43.1167	114.03	IQ V				
5+45	43.9053	114.51	IQ V				
5+50	44.6973	115.00	IQ V				
5+55	45.4927	115.50	IQ V				
6+ 0	46.2917	116.00	IQ V				
6+ 5	47.0941	116.51	IQ V				
6+10	47.9001	117.03	IQ V				
6+15	48.7096	117.55	IQ V				

6+20	49.5228	118.08	Q	V				
6+25	50.3397	118.61	Q	V				
6+30	51.1603	119.16	Q	V				
6+35	51.9847	119.70	Q	V				
6+40	52.8130	120.26	Q	V				
6+45	53.6451	120.82	Q	V				
6+50	54.4812	121.40	Q	V				
6+55	55.3213	121.97	Q	V				
7+ 0	56.1654	122.57	Q	V				
7+ 5	57.0136	123.16	Q	V				
7+10	57.8659	123.76	Q	V				
7+15	58.7225	124.37	Q	V				
7+20	59.5833	125.00	Q	V				
7+25	60.4485	125.62	Q	V				
7+30	61.3180	126.26	Q	V				
7+35	62.1920	126.90	Q	V				
7+40	63.0706	127.57	Q	V				
7+45	63.9537	128.22	Q	V				
7+50	64.8415	128.91	Q	V				
7+55	65.7339	129.59	Q	V				
8+ 0	66.6312	130.29	Q	V				
8+ 5	67.5334	130.99	Q	V				
8+10	68.4405	131.71	Q	V				
8+15	69.3526	132.44	Q	V				
8+20	70.2698	133.18	Q	V				
8+25	71.1922	133.93	Q	V				
8+30	72.1199	134.70	Q	V				
8+35	73.0528	135.47	Q	V				
8+40	73.9913	136.27	Q	V				
8+45	74.9352	137.06	Q	V				
8+50	75.8848	137.88	Q	V				
8+55	76.8401	138.70	Q	V				
9+ 0	77.8012	139.56	Q	V				
9+ 5	78.7682	140.41	Q	V				
9+10	79.7413	141.29	Q	V				
9+15	80.7204	142.17	Q	V				
9+20	81.7058	143.08	Q	V				
9+25	82.6975	143.99	Q	V				
9+30	83.6957	144.94	Q	V				
9+35	84.7004	145.88	Q	V				
9+40	85.7118	146.87	Q	V				
9+45	86.7301	147.85	Q	V				
9+50	87.7553	148.87	Q	V				
9+55	88.7876	149.89	Q	V				
10+ 0	89.8272	150.95	Q	V				
10+ 5	90.8741	152.01	Q	V				
10+10	91.9286	153.11	Q	V				
10+15	92.9907	154.22	Q	V				
10+20	94.0607	155.37	Q	V				
10+25	95.1387	156.52	Q	V				
10+30	96.2249	157.72	Q	V				
10+35	97.3193	158.92	Q	V				
10+40	98.4224	160.17	Q	V				
10+45	99.5342	161.42	Q	V				
10+50	100.6549	162.73	Q	V				
10+55	101.7847	164.04	Q	V				
11+ 0	102.9239	165.41	Q	V				
11+ 5	104.0726	166.79	Q	V				
11+10	105.2312	168.22	Q	V				
11+15	106.3997	169.67	Q	V				
11+20	107.5785	171.17	Q	V				
11+25	108.7678	172.69	Q	V				
11+30	109.9681	174.27	Q	V				

11+35	111.1793	175.87	Q	V			
11+40	112.4020	177.54	Q	V			
11+45	113.6362	179.21	Q	V			
11+50	114.8826	180.98	Q	V			
11+55	116.1412	182.75	Q	V			
12+ 0	117.4127	184.61	Q	V			
12+ 5	118.6953	186.24	Q	V			
12+10	119.9853	187.30	Q	V			
12+15	121.2759	187.39	Q	V			
12+20	122.5527	185.40	Q	V			
12+25	123.8184	183.78	Q	V			
12+30	125.0826	183.56	Q	V			
12+35	126.3511	184.19	Q	V			
12+40	127.6274	185.32	Q	V			
12+45	128.9134	186.73	Q	V			
12+50	130.2113	188.45	Q	V			
12+55	131.5222	190.35	Q	V			
13+ 0	132.8480	192.50	Q	V			
13+ 5	134.1892	194.74	Q	V			
13+10	135.5475	197.22	Q	V			
13+15	136.9237	199.83	Q	V			
13+20	138.3196	202.68	Q	V			
13+25	139.7356	205.61	Q	V			
13+30	141.1735	208.78	Q	V			
13+35	142.6339	212.05	Q	V			
13+40	144.1188	215.61	Q	V			
13+45	145.6289	219.26	Q	V			
13+50	147.1662	223.22	Q	V			
13+55	148.7316	227.30	Q	V			
14+ 0	150.3276	231.73	Q	V			
14+ 5	151.9587	236.84	Q	V			
14+10	153.6369	243.68	Q	V			
14+15	155.3776	252.74	Q	V			
14+20	157.2147	266.75	Q	V			
14+25	159.1449	280.27	Q	V			
14+30	161.1541	291.73	Q	V			
14+35	163.2328	301.82	Q	V			
14+40	165.3804	311.83	Q	V			
14+45	167.5961	321.72	Q	V			
14+50	169.8834	332.12	Q	V			
14+55	172.2439	342.74	Q	V			
15+ 0	174.6838	354.27	Q	V			
15+ 5	177.2073	366.41	Q	V			
15+10	179.8233	379.85	Q	V			
15+15	182.5378	394.15	Q	V			
15+20	185.3639	410.35	Q	V			
15+25	188.2964	425.80	Q	V			
15+30	191.3139	438.15	Q	V			
15+35	194.3714	443.94	Q	V			
15+40	197.3624	434.30	Q	V			
15+45	200.3348	431.58	Q	V			
15+50	203.4218	448.24	Q	V			
15+55	206.7612	484.87	Q	V			
16+ 0	210.6019	557.67	Q	V			
16+ 5	215.9200	772.19	Q	V			
16+10	224.1854	1200.13	Q	V			
16+15	236.3640	1768.33		V		Q	
16+20	254.8039	2677.48			V		Q
16+25	271.5874	2436.97				V	Q
16+30	283.8995	1787.72					VQ
16+35	293.2505	1357.77			Q		V
16+40	301.1986	1154.06			Q		V
16+45	308.1502	1009.37			Q		V

16+50	314.3535	900.73			Q		V		
16+55	319.8884	803.67			Q		V		
17+ 0	324.9338	732.59			Q		V		
17+ 5	329.6131	679.43			Q		V		
17+10	333.9028	622.86			Q		V		
17+15	337.7710	561.67			Q		V		
17+20	341.3151	514.60			Q		V		
17+25	344.6099	478.40			Q		V		
17+30	347.6708	444.44			Q		V		
17+35	350.5354	415.94			Q		V		
17+40	353.1800	383.99		Q			V		
17+45	355.6998	365.87		Q			V		
17+50	358.0461	340.68		Q			V		
17+55	360.2712	323.09		Q			V		
18+ 0	362.3582	303.03		Q			V		
18+ 5	364.3099	283.39		Q			V		
18+10	366.1690	269.94		Q			V		
18+15	367.9021	251.65		Q			V		
18+20	369.6098	247.95		Q			V		
18+25	371.3183	248.08		Q			V		
18+30	373.0058	245.03		Q			V		
18+35	374.6596	240.13		Q			V		
18+40	376.2741	234.42		Q			V		
18+45	377.8236	224.99		Q			V		
18+50	379.2802	211.50		Q			V		
18+55	380.6935	205.21		Q			V		
19+ 0	382.0261	193.50		Q			V		
19+ 5	383.2852	182.81		Q			V		
19+10	384.5171	178.87		Q			V		
19+15	385.7252	175.42		Q			V		
19+20	386.9106	172.13		Q			V		
19+25	388.0740	168.92		Q			V		
19+30	389.2166	165.91		Q			V		
19+35	390.3396	163.06		Q			V		
19+40	391.4439	160.34		Q			V		
19+45	392.5305	157.77		Q			V		
19+50	393.6004	155.35		Q			V		
19+55	394.6544	153.04		Q			V		
20+ 0	395.6933	150.85		Q			V		
20+ 5	396.7179	148.77		Q			V		
20+10	397.7288	146.77		Q			V		
20+15	398.7262	144.83		Q			V		
20+20	399.7108	142.96		Q			V		
20+25	400.6831	141.18		Q			V		
20+30	401.6436	139.46		Q			V		
20+35	402.5927	137.81		Q			V		
20+40	403.5308	136.21		Q			V		
20+45	404.4582	134.67		Q			V		
20+50	405.3753	133.16		Q			V		
20+55	406.2822	131.69		Q			V		
21+ 0	407.1794	130.26		Q			V		
21+ 5	408.0668	128.86		Q			V		
21+10	408.9449	127.50		Q			V		
21+15	409.8140	126.18		Q			V		
21+20	410.6742	124.90		Q			V		
21+25	411.5258	123.66		Q			V		
21+30	412.3692	122.45		Q			V		
21+35	413.2044	121.28		Q			V		
21+40	414.0317	120.13		Q			V		
21+45	414.8514	119.02		Q			V		
21+50	415.6636	117.93		Q			V		
21+55	416.4686	116.88		Q			V		
22+ 0	417.2664	115.85		Q			V		

22+ 5	418.0573	114.84	Q				V	
22+10	418.8415	113.86	Q				V	
22+15	419.6191	112.90	Q				V	
22+20	420.3902	111.97	Q				V	
22+25	421.1551	111.06	Q				V	
22+30	421.9138	110.16	Q				V	
22+35	422.6665	109.29	Q				V	
22+40	423.4133	108.44	Q				V	
22+45	424.1544	107.60	Q				V	
22+50	424.8899	106.79	Q				V	
22+55	425.6198	105.99	Q				V	
23+ 0	426.3444	105.21	Q				V	
23+ 5	427.0637	104.44	Q				V	
23+10	427.7778	103.69	Q				V	
23+15	428.4868	102.95	Q				V	
23+20	429.1909	102.23	Q				V	
23+25	429.8901	101.53	Q				V	
23+30	430.5846	100.83	Q				V	
23+35	431.2743	100.15	Q				V	
23+40	431.9595	99.49	Q				V	
23+45	432.6402	98.83	Q				V	
23+50	433.3164	98.19	Q				V	
23+55	433.9882	97.56	Q				V	
24+ 0	434.6559	96.94	Q				V	
24+ 5	435.3122	95.30	Q				V	
24+10	435.9386	90.96	Q				V	
24+15	436.5076	82.61	Q				V	
24+20	436.9574	65.32	Q				V	
24+25	437.2991	49.62	Q				V	
24+30	437.5704	39.39	Q				V	
24+35	437.7952	32.64	Q				V	
24+40	437.9844	27.48	Q				V	
24+45	438.1457	23.42	Q				V	
24+50	438.2841	20.09	Q				V	
24+55	438.4039	17.40	Q				V	
25+ 0	438.5081	15.12	Q				V	
25+ 5	438.5982	13.09	Q				V	
25+10	438.6763	11.34	Q				V	
25+15	438.7447	9.93	Q				V	
25+20	438.8046	8.71	Q				V	
25+25	438.8569	7.59	Q				V	
25+30	438.9024	6.60	Q				V	
25+35	438.9417	5.71	Q				V	
25+40	438.9759	4.97	Q				V	
25+45	439.0053	4.26	Q				V	
25+50	439.0306	3.67	Q				V	
25+55	439.0521	3.13	Q				V	
26+ 0	439.0705	2.66	Q				V	
26+ 5	439.0862	2.29	Q				V	
26+10	439.0997	1.95	Q				V	
26+15	439.1115	1.73	Q				V	
26+20	439.1220	1.51	Q				V	
26+25	439.1307	1.27	Q				V	
26+30	439.1378	1.02	Q				V	
26+35	439.1431	0.78	Q				V	
26+40	439.1468	0.53	Q				V	
26+45	439.1490	0.32	Q				V	
26+50	439.1503	0.19	Q				V	
26+55	439.1507	0.06	Q				V	



San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2018 Version 9.0
Rational Hydrology Study Date: 11/10/22

25-YEAR 1-HOUR
PRE-DEVELOPED
EARL GRAHAM

Program License Serial Number 6434

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 25.0
Computed rainfall intensity:
Storm year = 25.00 1 hour rainfall = 0.811 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

Process from Point/Station 0.000 to Point/Station 1.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
Initial subarea data:
Initial area flow distance = 547.200(Ft.)
Top (of initial area) elevation = 2948.000(Ft.)
Bottom (of initial area) elevation = 2890.000(Ft.)
Difference in elevation = 58.000(Ft.)
Slope = 0.10599 s(%)= 10.60
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.241 min.
Rainfall intensity = 2.796(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.714
Subarea runoff = 3.033(CFS)
Total initial stream area = 1.520(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.578(In/Hr)

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000

Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578 (In/Hr)
 Time of concentration = 10.24 min.
 Rainfall intensity = 2.796(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area, (total area with modified
 rational method) (Q=KCIA) is C = 0.714
 Subarea runoff = 16.583(CFS) for 8.310(Ac.)
 Total runoff = 19.616(CFS)
 Effective area this stream = 9.83(Ac.)
 Total Study Area (Main Stream No. 1) = 9.83(Ac.)
 Area averaged Fm value = 0.578 (In/Hr)

++++++
 Process from Point/Station 2.000 to Point/Station 3.000
 **** SUBAREA FLOW ADDITION ****

UNDEVELOPED (poor cover) subarea
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 67.00
 Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578 (In/Hr)
 Time of concentration = 10.24 min.
 Rainfall intensity = 2.796(In/Hr) for a 25.0 year storm
 Effective runoff coefficient used for area, (total area with modified
 rational method) (Q=KCIA) is C = 0.714
 Subarea runoff = 25.343(CFS) for 12.700(Ac.)
 Total runoff = 44.960(CFS)
 Effective area this stream = 22.53(Ac.)
 Total Study Area (Main Stream No. 1) = 22.53(Ac.)
 Area averaged Fm value = 0.578 (In/Hr)
 End of computations, Total Study Area = 22.53 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
 Area averaged SCS curve number = 67.0



San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2018 Version 9.0
Rational Hydrology Study Date: 11/10/22

100 YEAR 1 HOUR
DEVELOPED
EARL GRAHAM

ON-SITE DEVELOPED

Program License Serial Number 6434

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.100 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

Process from Point/Station 0.000 to Point/Station 1.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Adjusted SCS curve number for AMC 3 = 84.60
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.290 (In/Hr)
Initial subarea data:
Initial area flow distance = 547.200 (Ft.)
Top (of initial area) elevation = 2948.000 (Ft.)
Bottom (of initial area) elevation = 2890.000 (Ft.)
Difference in elevation = 58.000 (Ft.)
Slope = 0.10599 s(%)= 10.60
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.241 min.
Rainfall intensity = 3.792 (In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.831
Subarea runoff = 4.790 (CFS)
Total initial stream area = 1.520 (Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.290 (In/Hr)

Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000

Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Adjusted SCS curve number for AMC 3 = 52.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
 Time of concentration = 10.24 min.
 Rainfall intensity = 3.792(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area, (total area with modified
 rational method) (Q=KCIA) is C = 0.874
 Subarea runoff = 27.772(CFS) for 8.310(Ac.)
 Total runoff = 32.562(CFS)
 Effective area this stream = 9.83(Ac.)
 Total Study Area (Main Stream No. 1) = 9.83(Ac.)
 Area averaged Fm value = 0.111(In/Hr)

++++++
 Process from Point/Station 2.000 to Point/Station 3.000
 **** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
 Decimal fraction soil group A = 1.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 0.000
 SCS curve number for soil(AMC 2) = 32.00
 Adjusted SCS curve number for AMC 3 = 52.00
 Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.079(In/Hr)
 Time of concentration = 10.24 min.
 Rainfall intensity = 3.792(In/Hr) for a 100.0 year storm
 Effective runoff coefficient used for area, (total area with modified
 rational method) (Q=KCIA) is C = 0.878
 Subarea runoff = 42.443(CFS) for 12.700(Ac.)
 Total runoff = 75.005(CFS)
 Effective area this stream = 22.53(Ac.)
 Total Study Area (Main Stream No. 1) = 22.53(Ac.)
 Area averaged Fm value = 0.093(In/Hr)
 End of computations, Total Study Area = 22.53 (Ac.)
 The following figures may
 be used for a unit hydrograph study of the same area.
 Note: These figures do not consider reduced effective area
 effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.161
 Area averaged SCS curve number = 34.4



UNIT HYDROGRAPH ANALYSIS

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Study date 11/10/22 File: 2228UHD.out

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ON-SITE DEVELOPED

Program License Serial Number 6434

100-YEAR 24-HOUR
UNIT HYDROGRAPH
EARL GRAHAM

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Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

Area averaged rainfall isohyetal data:

Table with 2 columns: Sub-Area(Ac.), Rainfall (In). Values: 22.52, 4.06

Rainfall Distribution pattern used in study:
Type II for United States

+++++

***** Area-Averaged SCS Curve Number and Fm *****

Table with 6 columns: Area (Ac.), Area fract, SCS CN (AMC2), SCS CN (AMC3), Fm (In/Hr), Soil Group. Values: 3.63, 0.161, 34.4, 54.4, 0.100, A; 18.89, 0.839, 98.0, 98.0

Area-averaged catchment SCS Curve Number AMC(3) = 90.980

Area-averaged Fm value using values listed = 0.016(In/Hr)

+++++

User entry of time of concentration = 0.171 (hours)

Watershed area = 22.52(Ac.)

Catchment Lag time = 0.102 hours

Unit interval = 5.000 minutes

Unit interval percentage of lag time = 81.3802

Hydrograph baseflow = 0.00(CFS)

Minimum watershed loss rate(Fm) = 0.016(In/Hr)

Average adjusted SCS Curve Number = 90.980

Rainfall depth area reduction factors:

Using a total area of 22.52(Ac.) (Ref: SCS Sup A, Sec.4)

Arid and Semi-arid Climates ratio used

Areal factor ratio (rainfall reduction) = 1.000

Rainfall entered for study = 4.060(In)

Adjusted rainfall = 4.060(In)
 ++++++

The following unit hydrograph was developed using an S-Graph interpolated by time percentage of lag time vs. percentage of peak flow. The S-Graphs for Valley, Foothill, and Mountain were developed by the U.S. Army Corps of Engineers for use in the respective type of basins located in Southern California. (Hydrology San Gabriel River ... U.S. Engineer Office, Dec 1944, revised Jul 1946) The Desert S-Graph is from Report ... on ... Tahquitz Creek, California, same U.S. office, Corps of Engineers, June 1963. The Valley Developed S-Graph is used by Orange and San Bernardino counties in California to represent the characteristics of valley areas with a large amount of development. Because of the wide variety in topography in Southern California, these synthetic unit hydrographs were included for use as options in any geographic location.

The SCS (Soil Conservation Service Dimensionless S-Graph, SCS handbook, of 1972, applies to a broad cross section of geographic locations and hydrologic regions.

The User Defined hydrograph converts the user Q/Qp vs. T/Tp values into an S-Graph based on lag = Tp/0.9. Then, for the lag time used, the S-Graph is interpolated in time % of lag.

The following S-Graph or S-Graph combination is used in this study:

VALLEY DEVELOPED S-Graph

U N I T H Y D R O G R A P H

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Time Ratio (t/Lag)	Time (hrs)	Discharge Ratios (Q/Qp)	Q (CFS)	Mass Curve Ratios (Qa/Q)
	(K =	272.49 (CFS))		
0.81	0.083	0.219	31.818	0.117
1.63	0.167	1.000	145.596	0.651
2.44	0.250	0.548	79.798	0.944
3.26	0.333	0.085	12.356	0.989
4.07	0.417	0.020	2.924	1.000

+++++

For each time interval of the 6 or 24 hour storm, the total rainfall up to that storm time is calculated. Then the Soil Conservation Service SCS (report 1972, 1975) area averaged Curve Number (CN) is used to determine the amount of direct runoff in (In) using the following equations:

$$Q = \frac{(P - I_a)^2}{P - I_a + S}$$

Where:
 Q = direct runoff, P = depth of precipitation, Ia = Initial Abstraction and S is the watershed storage in inches. S and Ia are given by the following equations:

$$S = \frac{1000}{CN} - 10 \quad \text{and} \quad I_a = 0.2 S$$

Note: If Metric (SI) Units are used, rainfall data is converted by the program internally into inches for these calculations.

Note: In the following printout, the revised runoff column is only used when the minimum soil loss rate, fm, exceeds the normal loss rate of delta P(dP) - delta Q(dQ) then the dP-dQ column equals fm = 0.016(In) (for time interval = 0.001(In)) and the revised runoff is shown in the last column.

 Total soil rain loss = 1.12(In)
 Total effective runoff = 2.94(In)

Peak flow rate this hydrograph = 57.42(CFS)
 Total runoff volume this hydrograph = 240560.3(Ft3)

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24 - H O U R S T O R M
 R u n o f f H y d r o g r a p h

 Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	15.0	30.0	45.0	60.0
0+ 5	0.0000	0.00	Q				
0+10	0.0000	0.00	Q				
0+15	0.0000	0.00	Q				
0+20	0.0000	0.00	Q				
0+25	0.0000	0.00	Q				
0+30	0.0000	0.00	Q				
0+35	0.0000	0.00	Q				
0+40	0.0000	0.00	Q				
0+45	0.0000	0.00	Q				
0+50	0.0000	0.00	Q				
0+55	0.0000	0.00	Q				
1+ 0	0.0000	0.00	Q				
1+ 5	0.0000	0.00	Q				
1+10	0.0000	0.00	Q				
1+15	0.0000	0.00	Q				
1+20	0.0000	0.00	Q				
1+25	0.0000	0.00	Q				
1+30	0.0000	0.00	Q				
1+35	0.0000	0.00	Q				
1+40	0.0000	0.00	Q				
1+45	0.0000	0.00	Q				
1+50	0.0000	0.00	Q				
1+55	0.0000	0.00	Q				
2+ 0	0.0000	0.00	Q				
2+ 5	0.0000	0.00	Q				
2+10	0.0000	0.00	Q				
2+15	0.0000	0.00	Q				
2+20	0.0000	0.00	Q				
2+25	0.0000	0.00	Q				
2+30	0.0000	0.00	Q				
2+35	0.0000	0.00	Q				
2+40	0.0000	0.00	Q				
2+45	0.0000	0.00	Q				

2+50	0.0000	0.00	Q				
2+55	0.0000	0.00	Q				
3+ 0	0.0000	0.00	Q				
3+ 5	0.0000	0.00	Q				
3+10	0.0000	0.00	Q				
3+15	0.0000	0.00	Q				
3+20	0.0000	0.00	Q				
3+25	0.0000	0.00	Q				
3+30	0.0000	0.00	Q				
3+35	0.0000	0.00	Q				
3+40	0.0000	0.00	Q				
3+45	0.0000	0.00	Q				
3+50	0.0000	0.00	Q				
3+55	0.0000	0.00	Q				
4+ 0	0.0000	0.00	Q				
4+ 5	0.0000	0.00	Q				
4+10	0.0000	0.00	Q				
4+15	0.0001	0.01	Q				
4+20	0.0003	0.02	Q				
4+25	0.0005	0.03	Q				
4+30	0.0007	0.04	Q				
4+35	0.0011	0.05	Q				
4+40	0.0014	0.06	Q				
4+45	0.0019	0.06	Q				
4+50	0.0024	0.07	Q				
4+55	0.0029	0.08	Q				
5+ 0	0.0035	0.09	Q				
5+ 5	0.0043	0.11	Q				
5+10	0.0055	0.18	Q				
5+15	0.0072	0.24	Q				
5+20	0.0090	0.27	Q				
5+25	0.0111	0.30	Q				
5+30	0.0134	0.33	Q				
5+35	0.0157	0.33	Q				
5+40	0.0174	0.25	Q				
5+45	0.0189	0.21	Q				
5+50	0.0203	0.21	Q				
5+55	0.0218	0.21	Q				
6+ 0	0.0233	0.22	Q				
6+ 5	0.0249	0.24	Q				
6+10	0.0273	0.34	Q				
6+15	0.0300	0.40	Q				
6+20	0.0329	0.42	Q				
6+25	0.0359	0.44	Q				
6+30	0.0390	0.45	Q				
6+35	0.0423	0.48	Q				
6+40	0.0459	0.52	Q				
6+45	0.0497	0.55	Q				
6+50	0.0536	0.57	Q				
6+55	0.0577	0.59	Q				
7+ 0	0.0619	0.61	Q				
7+ 5	0.0662	0.62	Q				
7+10	0.0704	0.61	Q				
7+15	0.0745	0.60	Q				
7+20	0.0788	0.61	Q				
7+25	0.0831	0.63	Q				
7+30	0.0875	0.64	Q				
7+35	0.0922	0.68	Q				
7+40	0.0977	0.80	Q				
7+45	0.1037	0.88	Q				
7+50	0.1100	0.91	Q				
7+55	0.1164	0.93	Q				
8+ 0	0.1230	0.95	Q				

8+ 5	0.1294	0.94	Q						
8+10	0.1348	0.79	Q						
8+15	0.1397	0.71	QV						
8+20	0.1446	0.71	QV						
8+25	0.1495	0.71	QV						
8+30	0.1545	0.72	QV						
8+35	0.1598	0.77	QV						
8+40	0.1663	0.95	QV						
8+45	0.1737	1.07	QV						
8+50	0.1812	1.10	QV						
8+55	0.1889	1.12	QV						
9+ 0	0.1967	1.13	QV						
9+ 5	0.2050	1.20	QV						
9+10	0.2151	1.46	QV						
9+15	0.2263	1.62	IQ						
9+20	0.2378	1.67	IQ						
9+25	0.2495	1.70	IQ						
9+30	0.2614	1.73	IQ						
9+35	0.2734	1.75	IQ						
9+40	0.2853	1.72	IQV						
9+45	0.2971	1.71	IQV						
9+50	0.3090	1.73	IQV						
9+55	0.3210	1.75	IQV						
10+ 0	0.3332	1.77	IQV						
10+ 5	0.3467	1.96	IQV						
10+10	0.3655	2.73	IQV						
10+15	0.3874	3.19	IQ						
10+20	0.4102	3.31	IQ						
10+25	0.4335	3.38	IQV						
10+30	0.4571	3.43	IQV						
10+35	0.4803	3.37	IQV						
10+40	0.5004	2.91	IQ V						
10+45	0.5187	2.67	IQ V						
10+50	0.5370	2.65	IQ V						
10+55	0.5554	2.67	IQ V						
11+ 0	0.5739	2.69	IQ V						
11+ 5	0.5973	3.39	IQ V						
11+10	0.6423	6.54	Q						
11+15	0.7000	8.38	Q						
11+20	0.7607	8.82	Q						
11+25	0.8231	9.06	VQ						
11+30	0.8866	9.22	Q						
11+35	0.9841	14.15	V Q						
11+40	1.2352	36.47	V			Q			
11+45	1.5808	50.17	V				Q		
11+50	1.9530	54.05		V				Q	
11+55	2.3396	56.13		V				Q	
12+ 0	2.7351	57.42			V				Q
12+ 5	3.1018	53.25			V				Q
12+10	3.3101	30.25			Q	V			
12+15	3.4309	17.54		Q		V			
12+20	3.5384	15.61		Q		V			
12+25	3.6429	15.18		Q		V			
12+30	3.7478	15.22		Q		V			
12+35	3.8455	14.20		Q		V			
12+40	3.9100	9.36		Q		V			
12+45	3.9561	6.70		Q		V			
12+50	3.9995	6.29		Q		V			
12+55	4.0422	6.20		Q		V			
13+ 0	4.0849	6.21		Q		V			
13+ 5	4.1262	5.98		Q		V			
13+10	4.1601	4.93		Q		V			
13+15	4.1901	4.35		Q		V			

13+20	4.2195	4.27	Q			V	
13+25	4.2487	4.24	Q			V	
13+30	4.2779	4.24	Q			V	
13+35	4.3064	4.14	Q			V	
13+40	4.3315	3.64	Q			V	
13+45	4.3548	3.37	Q			V	
13+50	4.3777	3.33	Q			V	
13+55	4.4006	3.32	Q			V	
14+ 0	4.4235	3.32	Q			V	
14+ 5	4.4463	3.32	Q			V	
14+10	4.4692	3.32	Q			V	
14+15	4.4921	3.32	Q			V	
14+20	4.5150	3.32	Q			V	
14+25	4.5379	3.32	Q			V	
14+30	4.5607	3.32	Q			V	
14+35	4.5823	3.13	Q			V	
14+40	4.5977	2.24	Q			V	
14+45	4.6098	1.76	Q			V	
14+50	4.6214	1.68	Q			V	
14+55	4.6328	1.66	Q			V	
15+ 0	4.6443	1.66	Q			V	
15+ 5	4.6559	1.68	Q			V	
15+10	4.6682	1.78	Q			V	
15+15	4.6808	1.84	Q			V	
15+20	4.6935	1.85	Q			V	
15+25	4.7062	1.85	Q			V	
15+30	4.7190	1.85	Q			V	
15+35	4.7323	1.93	Q			V	
15+40	4.7483	2.33	Q			V	
15+45	4.7658	2.54	Q			V	
15+50	4.7836	2.58	Q			V	
15+55	4.8014	2.58	Q			V	
16+ 0	4.8192	2.58	Q			V	
16+ 5	4.8364	2.50	Q			V	
16+10	4.8509	2.10	Q			V	
16+15	4.8639	1.89	Q			V	
16+20	4.8766	1.85	Q			V	
16+25	4.8894	1.85	Q			V	
16+30	4.9021	1.85	Q			V	
16+35	4.9144	1.78	Q			V	
16+40	4.9246	1.49	Q			V	
16+45	4.9337	1.32	Q			V	
16+50	4.9427	1.30	Q			V	
16+55	4.9516	1.29	Q			V	
17+ 0	4.9605	1.29	Q			V	
17+ 5	4.9699	1.36	Q			V	
17+10	4.9813	1.65	Q			V	
17+15	4.9938	1.82	Q			V	
17+20	5.0064	1.84	Q			V	
17+25	5.0192	1.85	Q			V	
17+30	5.0319	1.85	Q			V	
17+35	5.0445	1.83	Q			V	
17+40	5.0563	1.73	Q			V	
17+45	5.0679	1.67	Q			V	
17+50	5.0793	1.66	Q			V	
17+55	5.0908	1.66	Q			V	
18+ 0	5.1022	1.66	Q			V	
18+ 5	5.1131	1.58	Q			V	
18+10	5.1212	1.18	Q			V	
18+15	5.1279	0.97	Q			V	
18+20	5.1343	0.93	Q			V	
18+25	5.1407	0.93	Q			V	
18+30	5.1471	0.93	Q			V	

18+35	5.1531	0.88	Q				V	
18+40	5.1579	0.69	Q				V	
18+45	5.1618	0.58	Q				V	
18+50	5.1657	0.56	Q				V	
18+55	5.1695	0.56	Q				V	
19+ 0	5.1733	0.56	Q				V	
19+ 5	5.1779	0.66	Q				V	
19+10	5.1859	1.16	Q				V	
19+15	5.1957	1.43	Q				V	
19+20	5.2058	1.47	Q				V	
19+25	5.2160	1.48	Q				V	
19+30	5.2262	1.48	Q				V	
19+35	5.2358	1.39	Q				V	
19+40	5.2426	1.00	Q				V	
19+45	5.2480	0.78	Q				V	
19+50	5.2532	0.75	Q				V	
19+55	5.2583	0.74	Q				V	
20+ 0	5.2634	0.74	Q				V	
20+ 5	5.2688	0.78	Q				V	
20+10	5.2755	0.98	Q				V	
20+15	5.2830	1.09	Q				V	
20+20	5.2907	1.11	Q				V	
20+25	5.2983	1.11	Q				V	
20+30	5.3059	1.11	Q				V	
20+35	5.3142	1.20	Q				V	
20+40	5.3251	1.59	IQ				V	
20+45	5.3376	1.81	IQ				V	
20+50	5.3502	1.84	IQ				V	
20+55	5.3629	1.85	IQ				V	
21+ 0	5.3757	1.85	IQ				V	
21+ 5	5.3873	1.70	IQ				V	
21+10	5.3943	1.01	Q				V	
21+15	5.3986	0.63	Q				V	
21+20	5.4025	0.57	Q				V	
21+25	5.4064	0.56	Q				V	
21+30	5.4102	0.56	Q				V	
21+35	5.4139	0.53	Q				V	
21+40	5.4169	0.44	Q				V	
21+45	5.4195	0.38	Q				V	
21+50	5.4221	0.37	Q				V	
21+55	5.4247	0.37	Q				V	
22+ 0	5.4272	0.37	Q				V	
22+ 5	5.4299	0.39	Q				V	
22+10	5.4333	0.49	Q				V	
22+15	5.4371	0.55	Q				V	
22+20	5.4409	0.55	Q				V	
22+25	5.4447	0.56	Q				V	
22+30	5.4486	0.56	Q				V	
22+35	5.4524	0.56	Q				V	
22+40	5.4562	0.56	Q				V	
22+45	5.4601	0.56	Q				V	
22+50	5.4639	0.56	Q				V	
22+55	5.4677	0.56	Q				V	
23+ 0	5.4716	0.56	Q				V	
23+ 5	5.4754	0.56	Q				V	
23+10	5.4792	0.56	Q				V	
23+15	5.4830	0.56	Q				V	
23+20	5.4869	0.56	Q				V	
23+25	5.4907	0.56	Q				V	
23+30	5.4945	0.56	Q				V	
23+35	5.4984	0.56	Q				V	
23+40	5.5022	0.56	Q				V	
23+45	5.5060	0.56	Q				V	

23+50	5.5099	0.56	Q				V
23+55	5.5137	0.56	Q				V
24+ 0	5.5175	0.56	Q				V
24+ 5	5.5209	0.49	Q				V
24+10	5.5222	0.19	Q				V
24+15	5.5225	0.03	Q				V
24+20	5.5225	0.01	Q				V

APPENDIX C

Infiltration Test:

GeoTek, Inc. Infiltration evaluation
dated June 29th 2023.
Project #3579-CR



GeoTek, Inc.
1548 North Maple Street, Corona, California 92878
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

June 29, 2023
Project No. 3579-CR

Transtech

413 Mackey Drive
San Bernardino, California 92408

Attention: Mr. David Mlynarski

Subject: **Infiltration Evaluation**
Proposed Container Storage Yard
Assessor's Parcel Number (APN) 0438-163-24-0000
9233 Deep Creek Road
Apple Valley area of San Bernardino County, California

References: See Page 6

Dear Mr. Mlynarski:

As requested, and authorized, GeoTek, Inc. (GeoTek) has performed an Infiltration Evaluation in order to provide infiltration testing for a proposed container storage yard to be constructed in Apple Valley, San Bernardino County, California. The intent of this study is to evaluate the infiltration properties of the subsurface soils within, and adjacent to, the proposed container storage yard. This report presents the results of the evaluation performed by GeoTek.

Site Description

The approximate 24.4-acre irregular-shaped project site is located at the eastern terminus of Outpost Road, east of Deep Creek Road, in an unincorporated area of San Bernardino County, near Apple Valley, California. Access to the site is available off Deep Creek Road via Outpost Road, a private unpaved gravel road that trends through the center of the parcel.

Topographically, site topography ranges from hillside terrain on the northeastern corner of the property to gently sloping terrain across of the majority of the proposed development site areas in the southern and western portions of the site. Site grades vary between 2,926 feet above mean sea level (amsl) towards the northeastern region and 2,885 feet amsl to the southwest. The site slopes down toward the southwest.

The the site is currently undeveloped land but used to store steel storage container units. A Burlington Northern Santa Fe (BNSF) railroad track runs adjacent to the eastern property line of the site. Site vegetation in the majority of the site consists of weeds, grasses and scattered brush. The site appears to have been disced in the past for vegetation control. A Site Location Map is presented as Figure 1 of this report.

Project Description

Based upon review of the *Conceptual Site Plan, Container Storage Yard* provided by Red Brick Solutions (Sheet 2 of 2, dated 2022), GeoTek understands that proposed site improvements are to consist of the construction of a container storage yard.

Field Exploration

Six (6) percolation test borings, Borings I-1 through I-6, were excavated with a track-mounted hollow stem auger drill rig. The tests were performed at depths ranging from five (5) to seven (7) feet below existing grade. Additionally, one (1) deep exploratory boring (Boring B-1) was excavated within the project area to a depth of approximately 15 feet for determination of depth of groundwater, if any, and for observation of any hardpan or impermeable layers. The approximate locations of the borings are indicated on the attached Boring Location Map, Figure 2.

All borings were approximately 8-inches in diameter. Four-inch diameter slotted PVC pipes encapsulated in filter sock were inserted into the six (6) percolation test holes. The annular space between the test hole sidewalls and PVC pipe was filled with gravel.

Soil/Geologic Conditions

The geologic units encountered in all borings consisted of alluvium. The alluvial soils consisted of silty sand and sand (SM and SP soil types based upon the Unified Soil Classification System). The logs of the borings are presented in Appendix A.

Groundwater

Groundwater or perched water was not encountered nor observed in any of the borings excavated for this evaluation. Based on a review of groundwater depths noted on the State Department of Water Resources Water Data Library website (<https://wdl.water.ca.gov/waterdatalibrary>), it is estimated a historic high groundwater depth in excess of 80 feet below existing grade exists at the site.

It is possible that seasonal variations (temperature, rainfall, etc.) will cause fluctuations in the groundwater level. Additionally, perched water may be encountered at shallow depths following extensive rain events, especially at soil/bedrock contacts or within the bedrock.

Infiltration Testing

Subsequent to pre-soaking the test holes in general conformance with the referenced document (County of San Bernardino, 2011), percolation testing was performed in the lower approximate 22 inches in each of the percolation borings. The percolation testing was conducted in general conformance with the referenced document prepared by the County of San Bernardino. The percolation rates were converted to an infiltration rate via the Porchet Method.

The infiltration rate for each of the tests is presented in the following table after the water level had stabilized.

Boring No.	Infiltration Rate (inches per hour)	Depth of Boring (feet)
Boring I-1	12.28	5
Boring I-2	20.31	5
Boring I-3	9.39	5
Boring I-4	16.42	5
Boring I-5	9.88	5
Boring I-6	2.18	7

Copies of the percolation data sheets and infiltration conversion sheets (Porchet Method) are included in Appendix B.

The reported infiltration rates are the measured rate without any factor of safety applied. Over the lifetime of the water quality facility, the infiltration rates may be affected by silt build up and biological activities, as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rates in design of the infiltration systems.

It should be noted that the infiltration rates provided above were performed in relatively undisturbed site materials. Infiltration rates will vary and are mostly dependent on the underlying consistency of the site soil and relative density. Infiltration rates will be impacted by weight of equipment travelling over the soil, placement of engineered fill and other various factors. GeoTek, Inc. assumes no responsibility or liability for the ultimate design or performance of the storm water facilities.

LIMITATIONS

The earth materials observed on the project site appear to be representative of the tested areas; however, soil materials vary in character between excavations and natural outcrops or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

GeoTek's conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

The opportunity to be of service on this project is sincerely appreciated. If you should have any questions, please do not hesitate to contact GeoTek.

Respectfully submitted,
GeoTek, Inc.



Edward H. LaMont
CEG 1892, Exp. 07/31/24
Principal Geologist

Bruce A. Hick
GE 2284, Exp. 12/31/24
Geotechnical Engineer

Anna M. Scott
Project Geologist

Cynthia Dias-Ruiz, EIT
Staff Engineer

Enclosures: Figure 1 – Site Location Map
Figure 2 – Boring Location Map
Appendix A – Logs of Exploratory Borings
Appendix B – Percolation Data Sheets and Conversion Sheets (Porchet Method)

Distribution: (1) Addressee via email (PDF file)

G:\Projects\3551 to 3600\3579CR Transtech APN 0438-163-24-0000 Apple Valley\Infiltration Evaluation\3579CR Infiltration Evaluation Apple Valley.doc

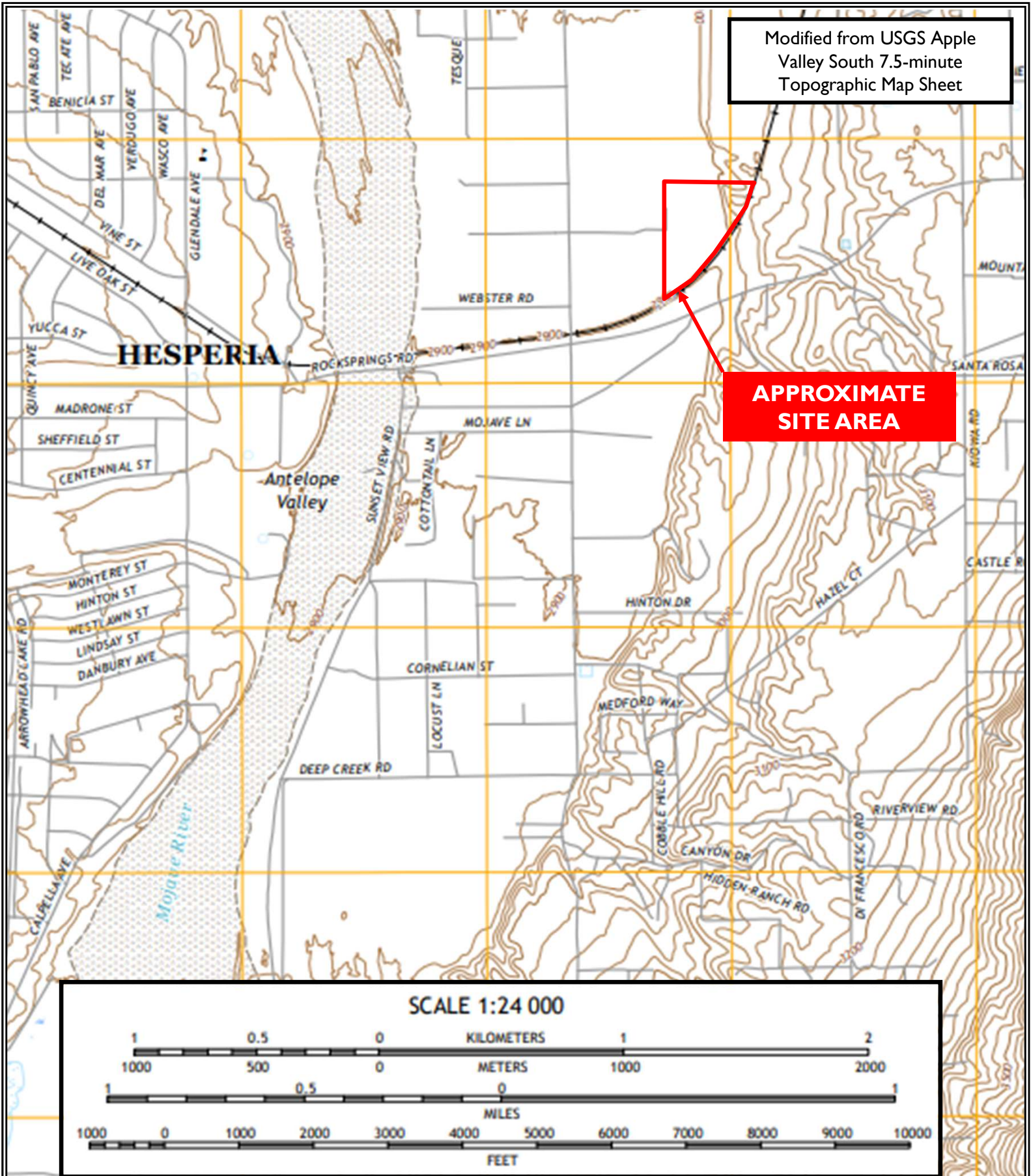
REFERENCES

Dibblee, T.W., 1973, "Geologic Map of the Lake Arrowhead Quadrangle", Open-File Report OF-73-56.

Red Brick Solution, 2022, "Conceptual Site Plan, Container Storage Yard, San Bernardino County, California", 1 sheet.

San Bernardino County, 2011, "Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations," dated May 19.

Modified from USGS Apple Valley South 7.5-minute Topographic Map Sheet



Transtech
APN 0438-163-24-0000
Apple Valley, San Bernardino County, California

Project No. 3579-CR



Figure I
Site Location Map





Transtech
 APN 0438-163-24-0000
 Apple Valley, San Bernardino County, California
 GeoTek Project No. 3579-CR

Figure 2
Boring Location Map



APPENDIX A

LOGS OF EXPLORATORY BORINGS

APN 0438-163-24-0000

Outpost Road and Deep Creek Road

Apple Valley, San Bernardino County, California

Project No. 3579-CR



GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Transtech
PROJECT NAME: APN 0438-163-24-0000
PROJECT NO.: 3579-CR
LOCATION: Apple Valley, CA

DRILLER: 2R Drilling
DRILL METHOD: Hollow Stem
HAMMER: 140#/30"

LOGGED BY: C.Diaz
OPERATOR: Victor
RIG TYPE: Track CME 75
DATE: 6/23/2023

Depth (ft)	SAMPLES			USCS Symbol	Boring No.: B-1 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
0					Alluvium: SP F-m SAND, tan, slightly moist, loose F-m SAND, grayish brown, slightly moist, loose			
5				SM	Silty f SAND, tan, slightly moist, medium dense			
10				SM-SP	Silty f SAND to f-m SAND, tan, slightly moist, medium dense			
15					BORING TERMINATED AT 15 FEET No groundwater encountered Boring backfilled with soil cuttings			
20								
25								
30								

LEGEND	Sample type:	<input type="checkbox"/> ---Ring	<input type="checkbox"/> ---SPT	<input type="checkbox"/> ---Small Bulk	<input checked="" type="checkbox"/> ---Large Bulk	<input type="checkbox"/> ---No Recovery	<input type="checkbox"/> ---Water Table	
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Transtech
PROJECT NAME: APN 0438-163-24-0000
PROJECT NO.: 3579-CR
LOCATION: Apple Valley, CA

DRILLER: 2R Drilling
DRILL METHOD: Hollow Stem
HAMMER: 140#/30"

LOGGED BY: C.Diaz
OPERATOR: Victor
RIG TYPE: Track CME 75
DATE: 6/23/2023

Depth (ft)	SAMPLES			USCS Symbol	Boring No.: I-I MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
0					Alluvium:			
				SM	Silty f-m SAND, grey brown, slightly moist, loose			
				SP	F-m SAND, grey brown, slightly moist, loose			
5					BORING TERMINATED AT 5 FEET			
					No groundwater encountered Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND	Sample type:	<input type="checkbox"/> ---Ring	<input type="checkbox"/> ---SPT	<input type="checkbox"/> ---Small Bulk	<input checked="" type="checkbox"/> ---Large Bulk	<input type="checkbox"/> ---No Recovery	<input type="checkbox"/> ---Water Table	
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Transtech
PROJECT NAME: APN 0438-163-24-0000
PROJECT NO.: 3579-CR
LOCATION: Apple Valley, CA

DRILLER: 2R Drilling
DRILL METHOD: Hollow Stem
HAMMER: 140#/30"

LOGGED BY: C.Diaz
OPERATOR: Victor
RIG TYPE: Track CME 75
DATE: 6/23/2023

Depth (ft)	SAMPLES			USCS Symbol	Boring No.: I-2	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
MATERIAL DESCRIPTION AND COMMENTS								
0					Alluvium: SP F-m SAND, tan, slightly moist, loose			
5	BORING TERMINATED AT 5 FEET No groundwater encountered Boring set with pipe, sock, and gravel							
10								
15								
20								
25								
30								

LEGEND	Sample type:	<input type="checkbox"/> ---Ring	<input type="checkbox"/> ---SPT	<input type="checkbox"/> ---Small Bulk	<input checked="" type="checkbox"/> ---Large Bulk	<input type="checkbox"/> ---No Recovery	<input type="checkbox"/> ---Water Table	
	Lab testing:	AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test	SR = Sulfate/Resistivity Test	SH = Shear Test	HC= Consolidation

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Transtech
PROJECT NAME: APN 0438-163-24-0000
PROJECT NO.: 3579-CR
LOCATION: Apple Valley, CA

DRILLER: 2R Drilling
DRILL METHOD: Hollow Stem
HAMMER: 140#/30"

LOGGED BY: C.Diaz
OPERATOR: Victor
RIG TYPE: Track CME 75
DATE: 6/23/2023

Depth (ft)	SAMPLES			USCS Symbol	Boring No.: I-3 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
0					Alluvium:			
				SM	Silty f SAND, grey brown, slightly moist, loose			
				SP	F-m SAND, tan brown, slightly moist, loose			
5					BORING TERMINATED AT 5 FEET			
					No groundwater encountered Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND	Sample type:	<input type="checkbox"/> ---Ring	<input type="checkbox"/> ---SPT	<input type="checkbox"/> ---Small Bulk	<input checked="" type="checkbox"/> ---Large Bulk	<input type="checkbox"/> ---No Recovery	<input type="checkbox"/> ---Water Table	
	Lab testing:	AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test	SR = Sulfate/Resistivity Test	SH = Shear Test	HC= Consolidation

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Transtech
PROJECT NAME: APN 0438-163-24-0000
PROJECT NO.: 3579-CR
LOCATION: Apple Valley, CA

DRILLER: 2R Drilling
DRILL METHOD: Hollow Stem
HAMMER: 140#/30"

LOGGED BY: C.Diaz
OPERATOR: Victor
RIG TYPE: Track CME 75
DATE: 6/23/2023

Depth (ft)	SAMPLES			USCS Symbol	Boring No.: I-4	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
MATERIAL DESCRIPTION AND COMMENTS								
0				SP	Alluvium: F-m SAND, tan, slightly moist, loose			
5	BORING TERMINATED AT 5 FEET No groundwater encountered Boring set with pipe, sock, and gravel							
10								
15								
20								
25								
30								

LEGEND	Sample type:	<input type="checkbox"/> ---Ring	<input type="checkbox"/> ---SPT	<input type="checkbox"/> ---Small Bulk	<input checked="" type="checkbox"/> ---Large Bulk	<input type="checkbox"/> ---No Recovery	<input type="checkbox"/> ---Water Table	
	Lab testing:	AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test	SR = Sulfate/Resistivity Test	SH = Shear Test	HC= Consolidation

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Transtech
PROJECT NAME: APN 0438-163-24-0000
PROJECT NO.: 3579-CR
LOCATION: Apple Valley, CA

DRILLER: 2R Drilling
DRILL METHOD: Hollow Stem
HAMMER: 140#/30"

LOGGED BY: C.Diaz
OPERATOR: Victor
RIG TYPE: Track CME 75
DATE: 6/23/2023

Depth (ft)	SAMPLES			USCS Symbol	Boring No.: I-5 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
0				SP	Alluvium: F-m SAND, slightly moist, brown, loose			
5					BORING TERMINATED AT 5 FEET No groundwater encountered Boring set with pipe, sock, and gravel			
10								
15								
20								
25								
30								

LEGEND	Sample type:	<input type="checkbox"/> ---Ring	<input type="checkbox"/> ---SPT	<input type="checkbox"/> ---Small Bulk	<input checked="" type="checkbox"/> ---Large Bulk	<input type="checkbox"/> ---No Recovery	<input type="checkbox"/> ---Water Table	
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT: Transtech
PROJECT NAME: APN 0438-163-24-0000
PROJECT NO.: 3579-CR
LOCATION: Apple Valley, CA

DRILLER: 2R Drilling
DRILL METHOD: Hollow Stem
HAMMER: 140#/30"

LOGGED BY: C.Diaz
OPERATOR: Victor
RIG TYPE: Track CME 75
DATE: 6/23/2023

Depth (ft)	SAMPLES			USCS Symbol	Boring No.: I-6 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
0					Alluvium: SM Silty F-m SAND, brown, slightly moist, loose			
5				SP	F-c SAND, brown, slightly moist, loose			
10					BORING TERMINATED AT 7 FEET No groundwater encountered Boring set with pipe, sock, and gravel			
15								
20								
25								
30								

LEGEND	Sample type:	<input type="checkbox"/> ---Ring	<input type="checkbox"/> ---SPT	<input type="checkbox"/> ---Small Bulk	<input checked="" type="checkbox"/> ---Large Bulk	<input type="checkbox"/> ---No Recovery	<input type="checkbox"/> ---Water Table	
	Lab testing:	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

APPENDIX B

PERCOLATION DATA AND CONVERSION SHEETS

APN 0438-163-24-0000

Outpost Road and Deep Creek Road

Apple Valley, San Bernardino County, California

Project No. 3579-CR



PERCOLATION DATA SHEET

Project: Transtech - APN 0438-163-24-0000, Apple Valley

Job No.: 3579-CR

Test Hole No.: I-1 **Tested By:** CD

Date: 6/23/2023

Depth of Hole As Drilled: 60" **Before Test:** 60"

After Test: 60"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	1:34 PM		60	22			1.14	
	1:59 PM	25			0	22		
2	2:01 PM		60	22			1.18	
	2:26 PM	25			0.75	21.25		
1	2:28 PM		60	22			0.54	
	2:38 PM	10			3.5	18.5		
2	2:40 PM		60	22			0.57	
	2:50 PM	10			4.5	17.5		
3	2:52 PM		60	22			0.59	
	3:02 PM	10			5	17		
4	3:04 PM		60	22			0.61	
	3:14 PM	10			5.5	16.5		
5	3:16 PM		60	22			0.62	
	3:26 PM	10			5.75	16.25		
6	3:28 PM		60	22			0.62	
	3:38 PM	10			5.75	16.25		



PERCOLATION DATA SHEET

Project: Transtech - APN 0438-163-24-0000, Apple Valley

Job No.: 3579-CR

Test Hole No.: I-2 **Tested By:** CD

Date: 6/23/2023

Depth of Hole As Drilled: 60" **Before Test:** 60"

After Test: 60"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	1:30 PM		60	22			1.14	
	1:55 PM	25			0	22		
2	1:57 PM		60	22			1.14	
	2:22 PM	25			0	22		
1	2:24 PM		60	22			0.45	
	2:34 PM	10			0	22		
2	2:36 PM		60	22			0.45	
	2:46 PM	10			0	22		
3	2:48 PM		60	22			0.45	
	2:58 PM	10			0	22		
4	3:00 PM		60	22			0.45	
	3:10 PM	10			0	22		
5	3:12 PM		60	22			0.45	
	3:22 PM	10			0	22		
6	3:24 PM		60	22			0.45	
	3:34 PM	10			0	22		



PERCOLATION DATA SHEET

Project: Transtech - APN 0438-163-24-0000, Apple Valley

Job No.: 3579-CR

Test Hole No.: I-3 **Tested By:** CD

Date: 6/23/2023

Depth of Hole As Drilled: 60" **Before Test:** 60"

After Test: 60"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	1:39 PM		60	22			1.14	
	2:04 PM	25			0	22		
2	2:06 PM		60	22			1.18	
	2:31 PM	25			0.75	21.25		
1	2:33 PM		60	22			0.59	
	2:43 PM	10			5	17		
2	2:45 PM		60	22			0.63	
	2:55 PM	10			6.25	15.75		
3	2:57 PM		60	22			0.68	
	3:07 PM	10			7.25	14.75		
4	3:09 PM		60	22			0.70	
	3:19 PM	10			7.75	14.25		
5	3:21 PM		60	22			0.73	
	3:31 PM	10			8.25	13.75		
6	3:33 PM		60	22			0.74	
	3:43 PM	10			8.5	13.5		



PERCOLATION DATA SHEET

Project: Transtech - APN 0438-163-24-0000, Apple Valley

Job No.: 3579-CR

Test Hole No.: I-4 **Tested By:** CD

Date: 6/23/2023

Depth of Hole As Drilled: 60" **Before Test:** 60"

After Test: 60"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	9:10 AM		60	22			1.14	
	9:35 AM	25			0	22		
2	9:37 AM		60	22			1.14	
	10:02 AM	25			0	22		
1	10:04 AM		60	22			0.45	
	10:14 AM	10			0	22		
2	10:16 AM		60	22			0.48	
	10:26 AM	10			1	21		
3	10:28 AM		60	22			0.48	
	10:38 AM	10			1	21		
4	10:40 AM		60	22			0.50	
	10:50 AM	10			2	20		
5	10:52 AM		60	22			0.51	
	11:02 AM	10			2.25	19.75		
6	11:04 AM		60	22			0.51	
	11:14 AM	10			2.5	19.5		



PERCOLATION DATA SHEET

Project: Transtech - APN 0438-163-24-0000, Apple Valley

Job No.: 3579-CR

Test Hole No.: I-5 **Tested By:** CD

Date: 6/23/2023

Depth of Hole As Drilled: 60" **Before Test:** 60"

After Test: 60"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	11:22 AM		60	22			1.18	
	11:47 AM	25			0.75	21.25		
2	11:49 AM		60	22			1.28	
	12:14 PM	25			2.5	19.5		
1	12:16 PM		60	22			0.67	
	12:26 PM	10			7	15		
2	12:28 PM		60	22			0.67	
	12:38 PM	10			7	15		
3	12:40 PM		60	22			0.69	
	12:50 PM	10			7.5	14.5		
4	12:52 PM		60	22			0.70	
	1:02 PM	10			7.75	14.25		
5	1:04 PM		60	22			0.71	
	1:14 PM	10			8	14		
6	1:16 PM		60	22			0.71	
	1:26 PM	10			8	14		



PERCOLATION DATA SHEET

Project: Transtech - APN 0438-163-24-0000, Apple Valley

Job No.: 3579-CR

Test Hole No.: I-6 **Tested By:** CD

Date: 6/23/2023

Depth of Hole As Drilled: 84" **Before Test:** 84"

After Test: 84"

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Rate (Minutes per Inch)	Comments
1	7:00 AM		84	22			2.00	
	7:25 AM	25			9.5	12.5		
2	7:27 AM		84	22			2.27	
	7:52 AM	25			11	11		
1	7:54 AM		84	22			2.00	
	8:04 AM	10			17	5		
2	8:06 AM		84	22			2.00	
	8:16 AM	10			17	5		
3	8:18 AM		84	22			2.00	
	8:28 AM	10			17	5		
4	8:30 AM		84	22			2.50	
	8:40 AM	10			18	4		
5	8:42 AM		84	22			2.50	
	8:52 AM	10			18	4		
6	8:54 AM		84	22			2.50	
	9:04 AM	10			18	4		



Client: Transtech
Project: APN 0438-163-24-0000
Project No: 3579-CR
Date: 6/26/2023

Boring No. I-1

Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 54.25
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 38
 Total Test Hole Depth, $D_T =$ 60

Equation - $I_t = \frac{\Delta H (60r)}{\Delta t (r+2H_{avg})}$

$H_O = D_T - D_O =$ 22
 $H_F = D_T - D_F =$ 5.75
 $\Delta H = \Delta D = H_O - H_F =$ 16.25
 $H_{avg} = (H_O + H_F) / 2 =$ 13.875

$I_t =$ 12.28 Inches per Hour



Client: Transtech
Project: APN 0438-163-24-0000
Project No: 3579-CR
Date: 6/26/2023

Boring No. I-2

Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 60
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 38
 Total Test Hole Depth, $D_T =$ 60

Equation - $I_t = \frac{\Delta H (60r)}{\Delta t (r+2H_{avg})}$

$H_O = D_T - D_O =$ 22
 $H_F = D_T - D_F =$ 0
 $\Delta H = \Delta D = H_O - H_F =$ 22
 $H_{avg} = (H_O + H_F) / 2 =$ 11

$I_t =$ 20.31 Inches per Hour



Client: Transtech
Project: APN 0438-163-24-0000
Project No: 3579-CR
Date: 6/26/2023

Boring No. I-3

Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 51.5
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 38
 Total Test Hole Depth, $D_T =$ 60

Equation - $I_t = \frac{\Delta H (60r)}{\Delta t (r+2H_{avg})}$

$H_O = D_T - D_O =$ 22
 $H_F = D_T - D_F =$ 8.5
 $\Delta H = \Delta D = H_O - H_F =$ 13.5
 $H_{avg} = (H_O + H_F) / 2 =$ 15.25

$I_t =$ 9.39 Inches per Hour

Client: Transtech
Project: APN 0438-163-24-0000
Project No: 3579-CR
Date: 6/26/2023

Boring No. I-4

Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 57.5
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 38
 Total Test Hole Depth, $D_T =$ 60

Equation - $I_t = \frac{\Delta H (60r)}{\Delta t (r+2H_{avg})}$

$H_O = D_T - D_O =$ 22
 $H_F = D_T - D_F =$ 2.5
 $\Delta H = \Delta D = H_O - H_F =$ 19.5
 $H_{avg} = (H_O + H_F) / 2 =$ 12.25

$I_t =$ 16.42 Inches per Hour



Client: Transtech
Project: APN 0438-163-24-0000
Project No: 3579-CR
Date: 6/26/2023

Boring No. I-5

Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 52
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 38
 Total Test Hole Depth, $D_T =$ 60

Equation -
$$I_t = \frac{\Delta H (60r)}{\Delta t (r+2H_{avg})}$$

$H_O = D_T - D_O =$ 22
 $H_F = D_T - D_F =$ 8
 $\Delta H = \Delta D = H_O - H_F =$ 14
 $H_{avg} = (H_O + H_F) / 2 =$ 15

$I_t =$ 9.88 Inches per Hour



Client: Transtech
Project: APN 0438-163-24-0000
Project No: 3579-CR
Date: 6/26/2023

Boring No. I-6

Infiltration Rate (Porchet Method)

Time Interval, $\Delta t =$ 10
 Final Depth to Water, $D_F =$ 66
 Test Hole Radius, $r =$ 4
 Initial Depth to Water, $D_O =$ 62
 Total Test Hole Depth, $D_T =$ 84

Equation -
$$I_t = \frac{\Delta H (60r)}{\Delta t (r+2H_{avg})}$$

$H_O = D_T - D_O =$ 22
 $H_F = D_T - D_F =$ 18
 $\Delta H = \Delta D = H_O - H_F =$ 4
 $H_{avg} = (H_O + H_F) / 2 =$ 20

$I_t =$ 2.18 Inches per Hour

